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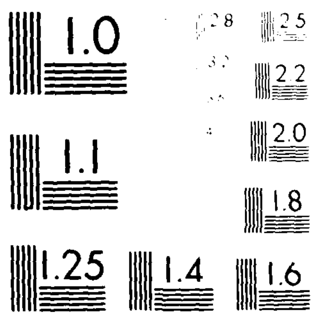
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THE DEVELOPMENT AND SUPPORT OF THE NATO PROJECT OPAQUE U.S.A.F. SYSTEM CONTROL PROGRAMS

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This report describes data processing programs which have been developed to edit, process, and analyze the digital raw data tapes produced at the U.S. Air Force Project OPAQUE Field Station in Meppen, Federal Republic of Germany. This raw data is produced by continuous measurements of atmospheric optical properties in the visible and infrared regions over the period beginning in December, 1976 through to the present. The report described the format of the raw data tapes and the programs and processing sequences used to generate appropriate

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20. ABSTRACT (continued)

files for producing time plots, histograms and tables. These files are available for subsequent repacking into the OPAQUE data bank format.

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Acknowledgements

The authors are indebted to their research associates, Prof. Peter Burger and Prof. Carl A. Stevens, for their invaluable assistance and expertise in the design and development of the programming system described herein. They also acknowledge the support and dedication of the Graduate Research Assistants, Mr. Peter Bixby and Mr. Edwin Kowaleski, along with Mr. William Wilson. The authors take full responsibility for the accuracy of any information contained in this report.

We also wish to thank Dr. Robert W. Fenn and Mr. Eric P. Shettle, OPA Contract Monitors, for providing the challenge and the technical assistance in developing solutions to the problems of dealing with large data bases.

INTRODUCTION

This report describes the control programs that have been developed to edit, process, and analyze the digital data tapes produced at the U.S. Air Force Project OPAQUE[1] Field Station located in Meppen, Federal Republic of Germany (abbr. F.R.G.). The objective of Project OPAQUE is to gather continuous data from a series of measurements in the visible and infrared regions for a period of two years or more. The requirement for continuous measurement of the experimental parameters has resulted in the design of a microprocessor-controlled, automated field station that samples and records the digital data on magnetic tape. The time span involved and the corresponding volume of data generated has created a large data base that must be accessed, processed, and analyzed by the experimenters.

Early in the design cycle, the ULowell Research Team set forth the following objectives based on the large volume of data collected and the number of researchers that would require access to that data:

1. All programs should be developed for both interactive and batch modes of processing. This is to allow access and processing from the ULowell remote location or from any terminal connected to the Cyber 74/74 System Computer at A.F.G.L.
2. The user should have a reasonable measure of control over output formats, search, and edit procedures.
3. Along with the customary features of tabulating or plotting data points, some additional methods of presentation should be provided to allow visual interpretation of long-term performance. This capability is deemed useful in all phases of processing and in the determination of the reliability factors to be assigned the data provided to the data bank.

1. Fenn, R. W. (1978) OPAQUE, Vol. I, AFGL-TR-78=0011

4. The programming language to be utilized is FORTRAN, and all subprograms are to be developed as "stand-alone" routines. This approach allows subprograms developed in one application to be used in other cases where the same algorithm is needed.

5. User access to the available programs should be through a simple control language. The control language chosen is one that has been developed by Prof. Robert J. Dirkman at the University of Lowell. Although the initial intent was to incorporate all programs in a system package, linked through this common control language, the core memory requirements for such a system dictate against doing so.

Using the objectives stated above, a number of programs have been developed and made operational on the A.F.G.L. Cyber 74/74 Shared Computer System. These programs are grouped according to the following functions:

Tape Editing and Tape Error Analysis

Raw Data File Generation

Sensor Performance and Analysis

Data Searching Procedures

Data Stripping into Minute, Second, and Four Second Data Files

Generation of the OPAQUE Data Bank Files

Data Plotting and Data Selection Display

It should be noted that the original program design was carried out on the ULowell Computer Facilities, which use the KRONOS operating system, after which they were transferred and made operational on the A.F.G.L. Computer System, which operates under the SCOPE operating system. All source programs are coded in FORTRAN and can be configured to operate in either batch or interactive mode. This report will emphasize the batch mode of operation as currently installed at A.F.G.L.

I. Overview of OPAQUE Data Processing Procedure

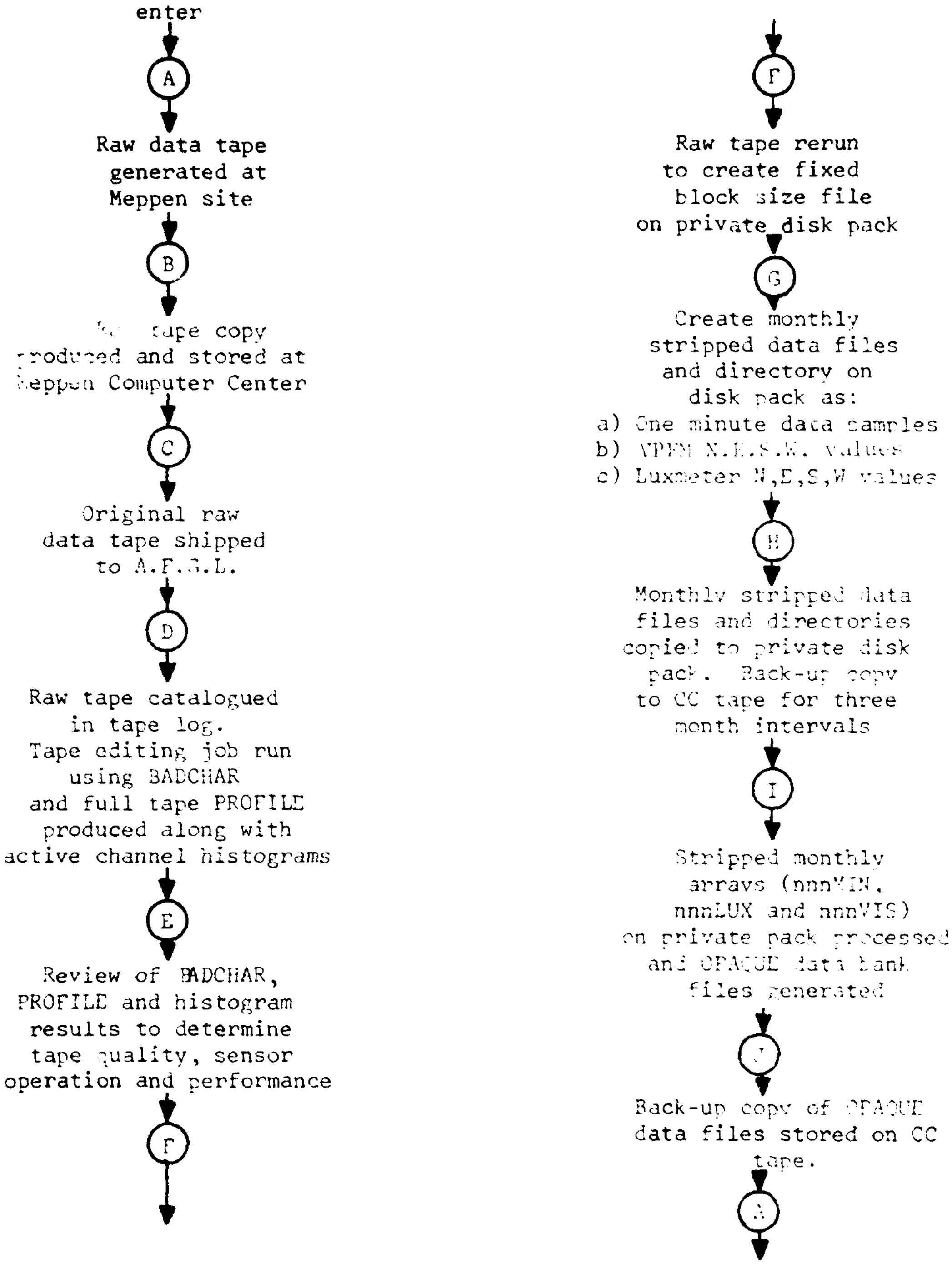
The accompanying flowchart, Figure I.A, shows the sequential processing steps that are performed on the OPAQUE data. The following comments are keyed to this figure using a letter code relating the comment line to the flowchart segment under discussion. Steps A through F are discussed in Part I, which describes the tape pre-processing phases; i.e., the raw data file generation and the sensor performance and analysis. Steps G through J are discussed in Part II, which describes the data searching and stripping procedures, generation of the OPAQUE data bank files, along with the plotting, selection, and display procedures.

A The sequence starts with the generation of a raw data tape on the system data logger at the U.S. OPAQUE site at Meppen, F.R.G. The data logger characteristics are given in Section I.1, and the raw data tape format is described in Section I.2.

B A back-up copy of the raw data tape is produced and stored at the Meppen Test Range Computer Center at Meppen, F.R.G. The back-up tape copies are retained until it is determined that the original raw data tape received at the Atmospheric Optics Branch is of usable quality. A raw tape processing program was developed and made operational by ULowell on the Meppen Computer Center TR-4 computer to strip out and dump selected raw tape hexidecimal blocks in display code. This program is described in Section I.3.

C The raw data tapes are air mailed to A.F.G.L. with the ULowell research team maintaining the raw tape data bank. The raw tape data log is given in Section I.4.

D Upon receipt at A.F.G.L., each raw data tape is edited to determine the



OPAQUE Data Processing Sequence - Figure I.A

quality of the data recording, vis, the number of invalid hex characters, the number of data and time word format errors, the number of block size errors, and end-of-record (EOR) and end-of-file (EOF) mark errors. The data tape utility program ILLCHAR, described in Section I.5 is used to perform this analysis. The data file is rewound and the sensor performance program STRPHEX is executed. The output of STRPHEX is a coded presentation that displays each active data channel over the complete time interval of the raw data tape, usually three days. In addition, STRPHEX can also produce a histogram plot for each active data channel for the raw tape duration. A complete description of STRPHEX is given in Section I.6.

E The printouts produced by BADCHAR and STRPHEX are reviewed to identify potential problem areas in the data stripping and sequencing phases. Analysis of the STRPHEX outputs assists in determining current sensor status and operational values.

F The raw data tape is rerun and the program BLOCK produces a data file of uniform block sizes on the private disk pack, MDATA1. Four consecutive raw data tapes are blocked and loaded to the disk pack for additional processing. A discussion of the program BLOCK can be found in Section I.7. It should be noted that the raw tape or the disk pack raw data file can be rerun with the program STRPHEX to obtain "quick-look" plots of selected sensor voltage outputs or sensor data frequency of occurrence.

G The next phase involves stripping the one minute samples from the raw data disk files on the disk pack MDATA1 and packing and formatting these samples into the monthly minute files on system storage. Entries are made into the associated minute file directory regarding the time, date, and duration and file address of each raw data entry. An overview of the data stripping and file generation process is given in Part II.

The one minute data channel stripping program, NEWSTRIP, is described in Section II.1. A similar procedure is used to strip the four second illumination data from the Luxmeter into the monthly Luxmeter file and directory using the program STRPLX described in Section II.2. The Variable Path Function Meter (VPFM) data are also stripped from the raw data files on a monthly basis using the program STRPVS, which is described in Section II.3. To assist in the user interface with the program packages, a JOB control card procedure file has been developed for each of the three stripping operations above, named MINSTRIP, LUXSTRIP, and VISSTRIP. These procedure files contain the appropriate SCOPE control cards stored sequentially and executed by a control card call to the procedure file. The contents of the monthly stripped data files and their associated directories can be audited, depending on the file contents, using one of the status procedure files FILESTAT, LUXSTAT, or VISSTAT.

H As each of the three types of monthly stripped data files is completed, it is copied onto the private disk pack, LOWELL, along with its associated directory. When three consecutive months of data has been stripped and loaded onto the private disk pack, a back-up copy of the contents of the private pack is made to a CC tape.

I The stripped monthly data files are processed to produce the OPAQUE data bank formatted files using the programs ERIK, ERKLUX, and ERKVIS, which are described in Section II.5. The OPAQUE data bank files are stored on system disk storage and made available to the A.F.G.L. SU group for insertion of the associated meterological and data reliability figures. The completed OPAQUE data bank files are then recorded on magnetic tape and sent to the data bank in the U.K. It should be noted that the stripping programs also can generate plots and histograms in scientific units from the stripped data files created in step H. These capabilities are described in Section II.4 below.

J A back-up copy of the OPAQUE data bank files is stored on CC tape for future use.

A The sequence is then repeated for additional raw data tapes.

The sequence described above was designed to handle the raw data tapes on either a production basis or a single tape job run using system procedure files that load and execute the appropriate main program and the required subprograms.

I.1 DATA LOGGER SYSTEM

The Data Logger System used in the collection, formatting, and recording of the data sensor outputs was designed and developed at A.F.G.L. based on an Intel 8008 microprocessor. The basic system consists of: eight program-controlled input ports, eight program-controlled output ports, a fourteen bit address bus, an eight-bit buffered data bus, 2,256 bytes of RAM and 256 bytes of PROM memory, along with a microprocessor controlled IEEE-488 programmable interface bus. The basic design criteria used was to retain complete system control in the memory-resident software control algorithm to allow maximum flexibility in sensor sampling time, sequencing, data formatting, and recording.

The processor communicates with the experimental instrumentation and the system peripherals (i.e., the teletype, the magnetic tape recorder, the system time/day clock, and the analog-to-digital converter) through the eight line, bidirectional, buffered data bus. Digital information is provided to the microcomputer in groups of eight bits, each bit being two-valued; i.e., 1 or 0. These groups of 8-bits constitute a byte, and provisions are made in the design to accept eight separate data input sources (called INPUT ports). These input sources can represent either STATUS information (i.e., the current state or phase of operation) or DATA from an external device.

In turn, the microcomputer can send out 8-bit bytes on the data bus and latch or store these bytes in any of the eight OUTPUT registers. The bytes stored in these output registers represent either a COMMAND or a DATA byte to the external devices.

The functional block diagram in Figure I.1.A shows the data logger with its eight INPUT ports and the eight OUTPUT registers. From this figure one

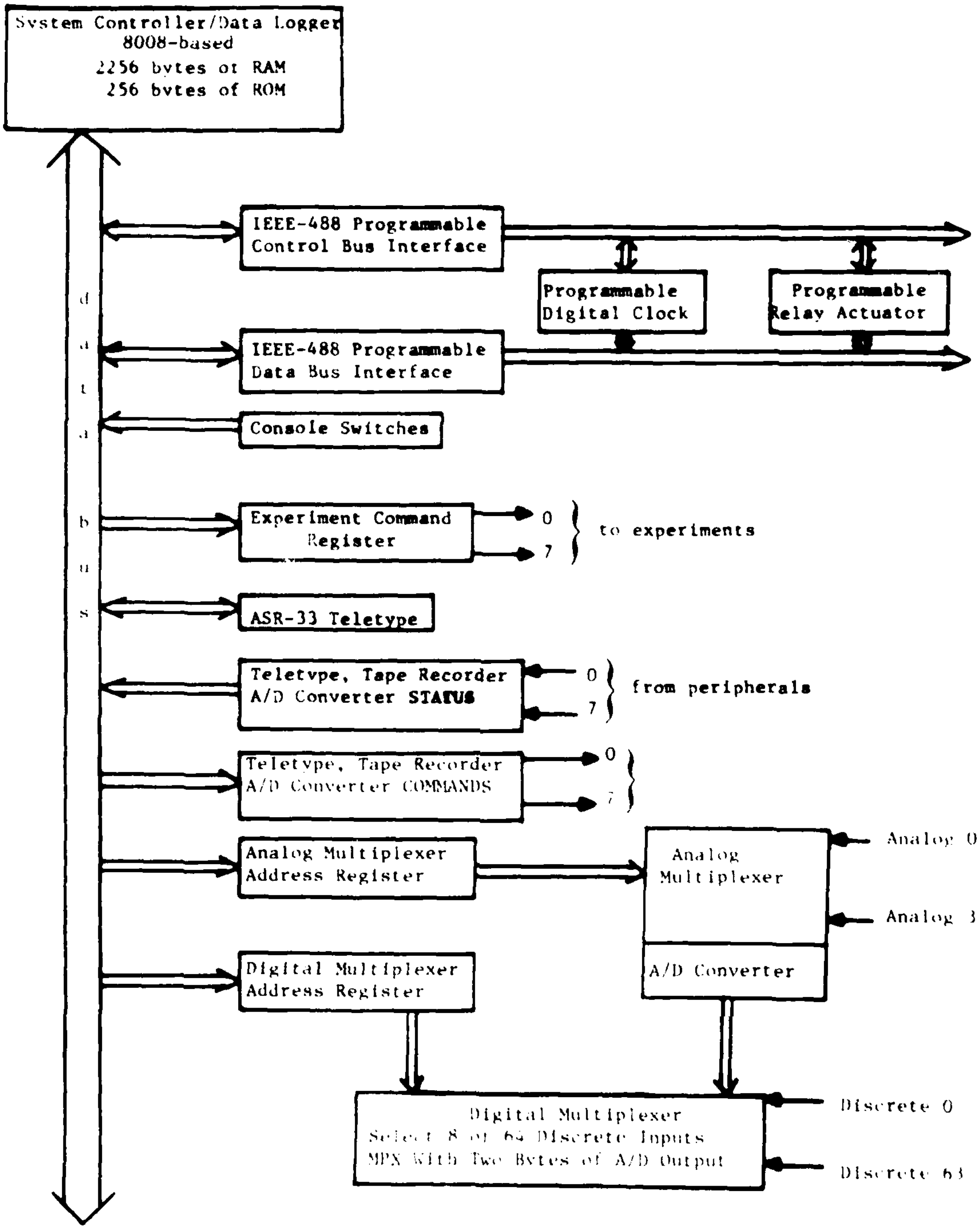


FIGURE I.1.A. DATA LOGGER FUNCTIONAL BLOCK DIAGRAM

can note that the microprocessor can provide a mapping of the eight input bytes onto the eight output registers. The dominant aspect of the figure is that the microprocessor forms the "link" between the INPUT ports and the OUTPUT registers. Thus, through the use of the appropriate control program (software, stored in memory) the microprocessor can "link" any INPUT port to any OUTPUT register(s), determine the STATUS of any connected, external device, or issue a COMMAND to any external device. As all data bytes pass through the processor from INPUT to OUTPUT, additional control operations, such as data formatting, can be performed on data bytes while passing through the data logger.

The central role that the processor plays is its ability to test for the current STATUS of a given device, the ability to accept DATA from a device, the ability to COMMAND a device to perform a specific operation or function, and to provide DATA to a specific device, all under the control of a program demonstrates the power of a software control structure. Essentially, one writes a short program to control each and every device connected to the data logger. These control programs are tailored to the characteristics of the devices and form the software control interfaces. The hardware portion of the interface resides in the device assigned INPUT port(s) and OUTPUT register(s).

In summary, the concept of separating the control structure into its hardware and software segments yields considerable flexibility and versatility to the data logger design. Although only eight INPUT ports and eight OUTPUT registers are currently provided, additional ports and registers can be added by providing the necessary hardware and the software control programs.

Data Sampling, Sequencing, and Format Control Programs

The data logger design, being microprocessor based, separates the control structure into hardware and software segments. The hardware segment provides eight programmable input ports and eight programmable output ports. The input ports allow entry of digital information from sources external to the data logger representing either STATUS information or DATA. The output ports provide either COMMAND information or DATA to external devices. In its simplest form, the data logger provides a mapping of the eight input ports onto the eight output ports. The control programs necessary to perform this mapping reside in a 2K random access memory in the data logger.

The flowchart given in Figure I.1.B shows the sequential control structure used to implement the software portion of the design algorithm. The flexibility of the design is retained through the use of a short MAIN program that calls the modular subprograms in the order shown. All data input and output operations are in the programmed I/O mode with reserved memory buffer areas available to the control program segments. The algorithm is cyclical in operation and runs continuously under the control of system STATUS "flags". These one bit signal lines are monitored by the program and cause system WAIT or system HALT, depending on the monitored signal. HALT conditions are typically END-of-TAPE, peripheral not READY, etc.

The data logger dynamic performance can be monitored through the switch-programmable panel display in octal or decimal digits and through the use of the utility program, QLOOK, that produces an ASCII formatted printout on the teletype of the most recent 256 hexidecimal data bytes written to the magnetic tape.

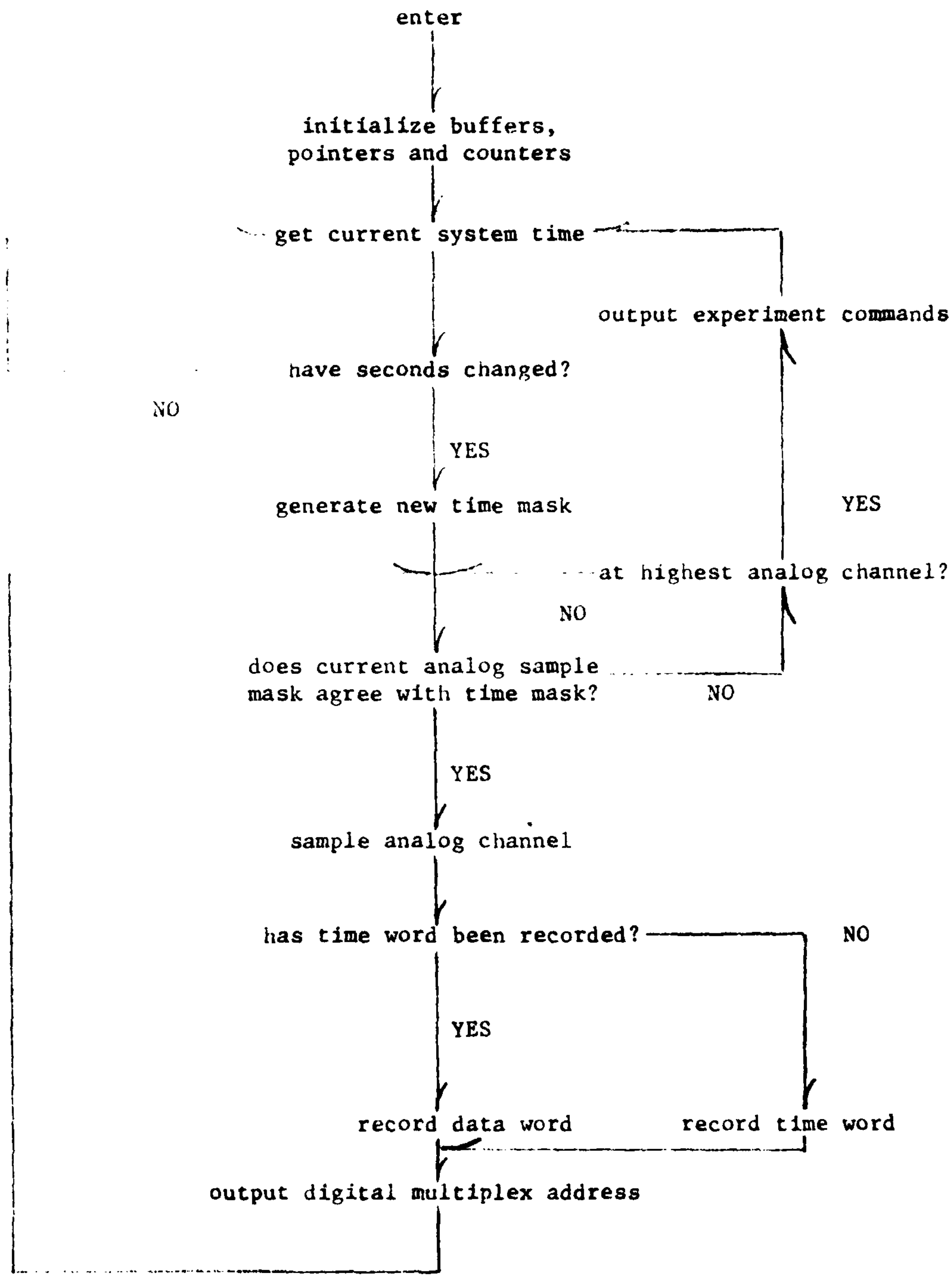


FIGURE I.1.B Data Logger Control Algorithm

Based on the NATO/OPAQUE data sampling rates and frequency, a complete set of control programs has been designed and developed. A combination memory map and listing of the programs that are currently operational at the Meppen Field Station is given below.

Page	Address	Name	Function
Ø	70-212	MAIN	The primary control sequence program
Ø	250-333	CH Test	Analog channel service program
1	200-312	TIME	Stores time values and determines one second and one minute time changes
1	000-162	CLOCK	Control program for HP Interface Bus addresses and reads digital clock
1	320-367	TPTFMT	Time Print/Record Format Control
2	000-0[illegible]	TYMSYN	Determines four second, ten minute, and thirty minute intervals
2	07[illegible]-[illegible]23	STCK	Determines status of magnetic tape recorder
2	030-[illegible]50	SCANSEC	Determines odd or even hour
7	[illegible]40-1[illegible]	LUXSEC	Detects four second intervals
7	150-177	LUXLOG	Synchronizes second counter to minute time changes
2	140-177	BLKSZ	Fixes block size of digital data recorded on tape
2	200-222	MRCDR	Controls the operation of the magnetic tape recorder
2	260-302	SHIFT	Controls the circular shifting of a twelve byte array-variable number of shifted positions
2	320-377	PACKER	Stores eight or six-bit ASCII values in BCD form
3	000-025	DPTFMT	Data Print/Record Format Control
3	100-140	HOUSE	Discrete channel control array
3	300-340	REQST	Analog channel control array
4	000-061	DIGMUX	Digital Multiplex control program
4	200-303	CLEAR	System initialization program
7	210-240	QLOOK	Prints last 256 analog channel samples on system teletype in ASCII
6	200-243	MIN	Outputs one minute commands to system experiments
6	100-122	CRLF	Carriage return/line feed control for the teletype

Page	Address	Name	Function
4	100-133	TWTFMT	Time word format control programs
4	140-162	DWTFMT	Data word format control program
5	000-047	BINLD	Binary loading routine for system generated paper type
5	100-163	PDUMP	Program to punch paper tape
5	200-247	PROGIN	Keyboard input routine
5	300-372	MDUMP	Program to print in ASCII
6	000-062	PNTBIN	Conversion program, octal to ASCII
6	250-267	BLKCTR	Taper recorder block counter program
6	300-357	INSTIN	Enter machine instructions from key-board to memory
7	000-032	LOADER	Binary tape loading routine
7	050-060	LDLINK	Linking routine, used with QLOOK
7	242-273	XFER	Array transfer and format program
7	300-341	ADTEST	Analog channel address and display program
7	342-372	ENDE	Terminates recording at the end of the current block

The programs QLOOK, BINLD, PDUMP, MDUMP, INSTIN, ADTEST, and ENDE are utility Programs used for modification, testing, and diagnosis.

I.2 Raw Data Tape Format

The data recording format used consists of a time word followed by the data words for all channels to be sampled at that time. The asynchronous channel sampling used results in data word strings of various lengths. Each data channel can be programmed such that it is sampled at one or more of the following rates:

each minute, continuously

each minute for the first ten minutes of each hour

each second for the first ten minutes of each hour

each second for the first thirty minutes of alternate hours

every four seconds, continuously

Other sampling rates can be programmed as required.

A typical sample time string is given below where the three characters, ???, signify the start of a time word and the character, = , signifies the start of a data word.

???345120155 = 11007954 = 12006316 = 13006156 = 31457172 = 32466008 = 33464002
= 34466296???
345120156 = ...

As detailed in Table I.2.A, the day, hour, minute, and second value in the sample above is day 345 and time 12:01:55. The channel number appears after the data word sync/separator character, = . The channels in the sample above are 11, 12, 13 (VPFM samples), and 31, 32, 33, 34 (Scanning Nephelometer samples). This sample string is followed by the next time word given as day 345 at 12:01:56 and the next string of data words separated by the = character. The example above is generated from the packed, hexidecimal raw tape where the hex codes are converted to display codes. When originally installed, the data logger was programmed to

to record a packed 6-bit ASCII subset code but was reprogrammed for the 4-bit hexidecimal codes to conserve magnetic tape.

A detailed description of the data channel assignments, sampling rates, and the data word field use is given in Table I.2.A.

TABLE I.2.A

Raw Data Tape Formats

Time Word Format - twelve 4-bit Hex characters as

```
???dddhhmmss   where ??? identifies the start of a time word
                     ddd is day of year
                     hh is hour of day
                     mm is minute of day
                     ss is second of day
```

The time word identifies the start time of the analog data channel sampling sequence.

Data Word Format - nine 4-bit Hex characters as

```
=ccddaaaa      where = identifies the start of a data word
                     cc is the analog channel number
                     dd is the discrete channel value
                     aaaa is the number of "counts", proportional to the
                          analog voltage input
```

Instrument Sampling Rates

The various sensors are sampled at one of the following rates:

every minute, continuously
every minute for the first ten minutes of the hour
every second for the first ten minutes of the hour
every four second, continuously
every second for the first thirty minutes of alternate hours

The standard OPAQUE reporting period is the first ten minutes of every hour. As indicated above, many of the sensors are sampled through the whole hour, and these non-OPAQUE samples will be reported separately.

INSTRUMENT	DATA WORD FORMAT		SAMPLE RATE	SENSOR/OUTPUT
MRI NEPHELOMETER (before Apr.78)	=0000mnnn		1 minute, cont.	Channel 1
	=0100mnnn		1 minute, cont.	Channel 2
	=0200mnnn		1 minute, cont.	Channel 3
	=0300mnnn		1 minute, cont.	Channel 4
AEG POINT VISIBILITY METER (after Mar. 78)	=0000mnnn		1 minute, cont.	Channel 1
ELTRO VISIBLE TRANSMISSOMETER	=04xgmnnn	g = 0=Run, 1=Cal	1 minute, cont.	Transmission
NIGHT PATH RADIANCE METER	=0500mnnn		1 minute, cont.	Filter
	=0600mnnn		1 minute, cont.	Radiance
	=0700mnnn		1 minute, cont.	Range

INSTRUMENT	DATE WORD FORMAT		SAMPLE RATE	SENSOR/OUTPUT
VPFM	=1100mnnn		1 second/10 min	Photo Meter
	=1200mnnn		1 second/10 min	Azimuth
	=1300mnnn		1 second/10 min	Filter Position
LASER NEPHELOMETER	=1400mnnn		1 minute, cont.	PAP
	=1500mnnn		1 minute, cont.	Power Meter
	=1600mnnn		1 minute, cont.	Angle
	=1700mnnn		1 minute, cont.	[illegible]
TURBULENCE (500 m BARNES IR TRANS.)	=20xfmnnn	f = 0, 1, 2, 3 filter position	1 minute, cont.	D.C. Signal
BARNES (500m) IR TRANS.	=21xfmnnn	f = 0, 1, 2, 3 filter position	1 minute, cont.	Transmission
BARNES (1500m) IR TRANS.	=22fxmnnn	f = 0, 1, 2, 3 filter position	1 minute, cont.	Transmission
RAIN Gauge	=2300mnnn		1 minute, cont.	Rain Level
ILLUMINOMETER	=24gxmnnn	g = 0, 1, 3 gain	4 seconds, cont.	Vertical Sensor
	=25gxmnnn		4 seconds, cont.	Horizontal Sensor
	=26gxmnnn		4 seconds, cont.	Azimuth
SCANNING NEPHELOMETER	=31gfmnnn	g = 0 to 3 gain	1 second/30 minΔ	Angle of Rotn.
	=32gfmnnn		1 second/30 minΔ	Scale Shift
	=33gfmnnn	f = 0 to 7 filter	1 second/30 minΔ	Photo Diode
	=34gfmnnn		1 second/30 minΔ	Monitor

INSTRUMENT	DATA WORD FORMAT		SAMPLE RATE	SENSOR/OUTPUT
EPPLEY PYROHELIOMETER	=36xxmnnn	g = 0 to 3 gain sun sensor	1 minute, cont.	Direct Channel
	=37gfmnnn	f = 1 to 9 filter	1 minute, cont.	Filtered Channel

Note: In the data word format, x = do not care, f = discrete filter value, g = discrete gain value, m = high order digit of A/D count, and n = lower three digits.

Δ = alternate hours

I.3 Utility Program OPAQUE

The utility program OPAQUE was developed for use on the TELEFUNKEN TR-4 computer system at Meppen. This program is a modification of the function subprograms ICHAR and NDIF and the subroutine DATE used in the main program STRPHEX described in Section I.6. The implementation of this program presented several problems in that the FORTRAN routines BUFFER IN, BUFFER OUT, and SHIFT are non-existant in the TR-4 version of FORTRAN. The program ran correctly on our second try, but turn-around time was quite long due to the machine cycle time.

The final version of OPAQUE allows the user to skip a specified number of tape records and convert the hex characters to display codes and print the next record. The program is used to assist the field personnel in determining the quality of the raw tape and in debugging system problems at the Meppen Computer Center.

1.4 Raw Tape Log

The raw data tapes are sequentially numbered for identification and cataloging purposes. The tape assignment is made at the Meppen field site using the prefix OPA and a three digit number. The raw data tape log is kept on the CYBER 74/74 system file, TAPEFILE, and can be listed out in two formats. The first is a sequential tabulation by OPA tape number giving the starting day of year and hour and the ending day of year and hour. The second format is a yearly mapping of data recordings using the day of month as the ordinate and the month of year as the abscissa with the OPA tape number indicating the daily AM and PM coverage.

The mapping for data year 1976 is given in Figure 1.4.A, the data year 1977 is given in Figure 1.4.B, and the data year 1978 (updated to June, 1978) is given in Figure 1.4.C.

A sample of the sequential tabulation is given in Figure 1.4.D for the current data year 1978.

OPA/MCDPEA TAPE LOG FOR 1976 RUN ON 07/10/78

	JAN AM	JAN PM	FEB AM	FEB PM	MAR AM	MAR PM	APR AM	APR PM	MAY AM	MAY PM	JUN AM	JUN PM	JUL AM	JUL PM	AUG AM	AUG PM	SEP AM	SEP PM	OCT AM	OCT PM	NOV AM	NOV PM	DEC AM	DEC PM
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	0	19	0	0	26	26	30	30
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	19	19	0	0	26	26	30	30
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	19	19	0	0	26	26	30	30
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	14	19	19	0	0	26	26	30	30
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	19	19	0	0	26	26	30	30
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	19	19	24	24	26	26	30	30
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	19	19	24	24	26	26	30	30
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	24	24	26	26	30	30
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	24	24	27	27	30	30
10	0	0	0	0	0	0	0	0	0	0	0	0	9	9	0	0	19	19	24	24	27	27	30	30
11	0	0	0	0	0	0	0	0	0	0	0	0	9	9	0	0	19	19	24	24	27	27	31	31
12	0	0	0	0	0	0	0	0	0	0	0	0	9	9	0	0	0	0	24	24	27	27	31	31
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	27	27	31	31
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	27	27	31	31
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	27	27	31	31
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	27	27	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	26	28	0	32
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
23	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	21	21	25	25	28	28	32	32
24	0	0	0	0	0	0	0	0	0	0	0	0	10	10	0	0	21	21	25	25	0	29	32	32
25	0	0	0	0	0	0	0	0	0	0	0	0	10	10	0	0	21	21	25	25	29	29	32	32
26	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0	21	21	25	25	29	29	32	32
27	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0	21	21	25	26	29	29	32	32
28	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0	21	21	26	26	29	29	33	33
29	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	26	26	29	29	33	33
30	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	0	0	0	26	26	30	30	33	33
31	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	0	0	0	26	26	0	0	33	33

FIGURE I.4.A. TAPE LOG FOR 1976

OPA/MEPPEN TAPE LOG FOR 1976 RUN ON 07/10/78

	JAN AM	JAN PM	FEB AM	FEB PM	MAR AM	MAR PM	APR AM	APR PM	MAY AM	MAY PM	JUN AM	JUN PM	JUL AM	JUL PM	AUG AM	AUG PM	SEP AM	SEP PM	OCT AM	OCT PM	NOV AM	NOV PM	DEC AM	DEC PM
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	0	19	0	0	26	26	30	30
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	19	19	0	0	26	26	30	30
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	19	19	0	0	26	26	30	30
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	14	19	19	0	0	26	26	30	30
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	19	19	0	0	26	26	30	30
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	19	19	24	24	26	26	30	30
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	19	19	24	24	26	26	30	30
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	24	24	26	26	30	30
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	24	24	27	27	30	30
10	0	0	0	0	0	0	0	0	0	0	0	0	9	9	0	0	19	19	24	24	27	27	30	30
11	0	0	0	0	0	0	0	0	0	0	0	0	9	9	0	0	19	19	24	24	27	27	31	31
12	0	0	0	0	0	0	0	0	0	0	0	0	9	9	0	0	0	0	24	24	27	27	31	31
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	27	27	31	31
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	27	27	31	31
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	27	27	31	31
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	27	27	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	28	28	0	32
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	25	25	28	28	32	32
23	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	21	21	25	25	28	28	32	32
24	0	0	0	0	0	0	0	0	0	0	0	0	10	10	0	0	21	21	25	25	0	29	32	32
25	0	0	0	0	0	0	0	0	0	0	0	0	10	10	0	0	21	21	25	25	29	29	32	32
26	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0	21	21	25	25	29	29	32	32
27	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0	21	21	25	26	29	29	32	32
28	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0	21	21	26	26	29	29	33	33
29	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	26	26	29	29	33	33
30	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	0	0	0	26	26	30	30	33	33
31	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	0	0	0	26	26	0	0	33	33

FIGURE I.4.A. TAPE LOG FOR 1976

OPA/MEPPEN TAPE LOG FOR 1977 RUN ON 07/10/78

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	33	33	38	38	46	46	53	53	64	64	74	74	84	84	90	90	97	98	104	104	112	112	121	121
2	33	33	38	38	46	46	53	53	65	65	74	74	84	84	90	91	98	98	0	0	112	112	122	122
3	33	33	38	38	0	0	0	0	65	65	75	75	84	84	91	91	98	98	0	0	112	112	122	122
4	33	33	39	39	0	0	54	54	65	65	75	75	85	85	91	91	98	98	0	0	113	113	122	122
5	0	0	39	39	0	0	54	54	0	66	75	75	85	85	91	91	99	99	0	0	113	113	123	123
6	0	0	39	39	0	0	54	55	67	67	75	76	85	85	91	91	99	99	0	0	113	113	123	123
7	0	0	39	40	0	0	56	56	67	67	76	76	85	86	91	91	99	99	105	105	113	114	123	123
8	0	0	40	40	47	47	56	56	67	67	76	76	86	86	92	92	99	99	105	105	114	114	123	123
9	0	0	40	40	47	47	56	56	68	68	76	76	86	86	92	92	99	0	105	105	114	115	124	124
10	0	0	40	40	47	0	56	56	68	68	77	77	86	0	92	92	0	0	105	106	115	115	124	124
11	0	0	41	41	48	48	56	0	68	68	0	0	0	0	92	92	0	0	106	106	115	116	124	124
12	0	0	41	41	48	48	57	57	68	69	0	0	0	0	92	0	0	100	106	106	116	116	124	125
13	0	0	41	41	48	48	57	57	69	69	78	78	0	87	0	0	100	100	106	106	116	116	125	125
14	0	0	41	41	48	48	57	58	69	69	78	78	87	87	0	0	100	100	107	107	117	117	125	125
15	0	0	42	42	48	0	59	59	69	69	79	79	87	0	93	93	100	101	107	107	117	117	125	125
16	0	0	42	0	49	49	59	59	69	70	80	80	0	0	93	93	101	0	107	107	117	117	126	126
17	0	0	0	0	49	0	59	59	70	70	80	80	0	0	93	93	0	0	108	108	117	117	126	126
18	0	0	0	0	50	50	59	60	70	70	80	80	0	0	93	93	0	0	108	108	118	118	126	126
19	0	0	0	0	50	50	60	60	70	70	80	80	0	0	94	94	0	0	108	108	118	118	126	127
20	0	0	0	0	50	50	60	60	71	71	81	81	88	88	94	94	0	0	108	109	118	118	127	127
21	35	35	44	44	50	0	60	60	71	71	81	81	89	89	0	95	0	0	109	109	119	119	127	127
22	0	0	44	44	51	51	61	61	71	71	81	81	89	89	95	95	0	0	109	109	119	119	127	127
23	0	0	0	0	51	51	61	61	72	72	81	81	89	89	95	95	102	102	109	109	119	119	128	128
24	0	0	0	0	51	0	61	61	72	72	82	82	89	89	95	95	102	102	109	110	119	119	128	0
25	0	0	45	45	52	52	61	62	72	72	82	82	89	89	96	96	102	102	110	110	120	120	0	0
26	36	36	45	45	52	52	62	62	72	72	82	82	89	89	96	96	102	102	110	110	120	120	0	0
27	36	36	45	45	52	52	0	63	73	73	83	83	90	90	96	96	103	103	110	110	120	120	129	129
28	36	37	46	46	52	52	63	63	73	73	83	83	90	90	96	96	103	103	110	111	120	121	129	129
29	37	37	0	0	53	53	64	64	73	73	83	83	90	90	96	97	104	104	111	111	121	121	129	129
30	37	37	0	0	53	53	64	64	73	73	83	83	90	90	97	97	104	104	111	111	121	121	130	130
31	37	38	0	0	53	53	0	0	74	74	0	0	90	90	97	97	0	0	111	111	0	0	130	130

FIGURE I.4.B. TAPE LOG FOR 1977

OPA/MEFPEN TAPE LOG FOR 1978 RUN ON 07/19/78

	JAN AM	JAN PM	FEB AM	FEB PM	MAR AM	MAR PM	APR AM	APR PM	MAY AM	MAY PM	JUN AM	JUN PM	JUL AM	JUL PM	AUG AM	AUG PM	SEP AM	SEP PM	OCT AM	OCT PM	NOV AM	NOV PM	DEC AM	DEC PM
1	0	0	137	137	144	144	151	151	160	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	131	131	137	137	144	144	151	151	161	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	131	131	138	138	144	144	151	152	161	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	131	131	138	138	145	145	152	152	161	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	131	131	138	138	145	145	152	152	162	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	132	132	139	139	145	145	152	152	162	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	132	132	139	139	145	145	153	153	162	162	0	174	0	0	0	0	0	0	0	0	0	0	0	0
8	132	132	139	139	145	145	153	153	162	163	174	174	0	0	0	0	0	0	0	0	0	0	0	0
9	132	0	139	139	146	146	153	153	163	163	174	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	140	140	146	146	154	154	163	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	140	140	146	146	154	154	163	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	133	133	140	140	146	146	155	155	164	164	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	140	141	146	146	155	156	164	164	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	141	141	147	147	156	156	164	164	178	178	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	141	141	147	147	156	156	164	164	178	178	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	141	141	147	147	156	156	164	165	179	179	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	142	142	148	148	157	157	165	165	179	179	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	142	142	148	148	157	157	165	165	179	179	0	0	0	0	0	0	0	0	0	0	0	0
19	0	134	142	142	148	148	157	157	166	166	180	180	0	0	0	0	0	0	0	0	0	0	0	0
20	134	134	142	142	148	148	157	158	166	166	180	180	0	0	0	0	0	0	0	0	0	0	0	0
21	134	134	142	143	149	148	158	158	166	166	180	180	0	0	0	0	0	0	0	0	0	0	0	0
22	134	134	143	143	148	148	158	158	166	167	180	180	0	0	0	0	0	0	0	0	0	0	0	0
23	135	135	143	143	149	149	158	158	167	167	180	0	0	0	0	0	0	0	0	0	0	0	0	0
24	135	135	143	143	149	149	159	159	167	167	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	135	135	143	143	149	149	159	159	167	167	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	135	135	143	143	149	149	159	159	168	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	136	136	143	144	149	149	159	159	168	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	136	136	144	144	150	150	160	160	168	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	136	136	0	0	150	150	160	160	168	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	137	137	0	0	150	150	160	160	0	170	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	137	137	0	0	151	151	0	0	170	170	0	0	0	0	0	0	0	0	0	0		0	0	0

FIGURE I.4.C. TAPE LOG FOR 1978

OPA No.	BEGIN DAY	BEGIN HR	END DAY	END HR
131	2	9	6	5
132	6	8	9	11
133	12	12	12	15
134	19	21	23	10
135	23	10	27	5
136	27	9	30	9
137	30	9	34	6
138	34	8	37	9
139	37	9	41	9
140	41	9	44	13
141	44	13	48	8
142	48	8	52	13
143	52	14	58	12
144	58	13	63	10
145	63	11	68	8
146	68	9	73	11
147	73	11	76	9
148	76	10	82	8
149	82	10	87	9
150	87	10	90	9
151	90	10	93	14
152	93	14	97	9
153	97	9	100	9
154	100	9	102	10
155	102	10	103	13
156	103	13	107	9
157	107	9	110	14
158	110	15	114	9
159	114	9	118	5
160	118	8	122	3
161	122	9	125	8
162	125	8	128	13
163	128	14	132	9
164	132	9	136	1
165	136	13	139	9
166	139	9	142	9
167	142	14	146	5
168	146	8	149	13
169	0	0	0	0
170	150	14	151	14
171	0	0	0	0
172	0	0	0	0
173	0	0	0	0
174	158	13	160	9
175	0	0	0	0
176	0	0	0	0
177	0	0	0	0
178	165	9	166	14
179	167	8	170	9
180	170	9	174	5

FIGURE I.4.D. DATA TAPE LISTING, JANUARY-JUNE, 1978

I.5 UTILITY PROGRAM ILLCHAR

The program ILLCHAR determines the total number of invalid hex characters per tape record, the total number of invalid characters over the recorded length of the tape, the total number of all characters recorded, and the percent error. The program also detects changes in tape record sizes, which for a perfect tape remains fixed at 3060 characters per record. This program can be used in two modes of operation. The tally mode accumulates the total number of records read, the total number of bad characters, the total number of characters read, and the total number of records with bad characters. Any change in record size is printed out along with the record number at which the size changed. This mode is used to determine the quality of the raw data tape and assists in determining the amount of preprocessing required by a given data tape.

The second mode of operation allows a more detailed analysis of the characters in error by printing the location within the record and the invalid character codes as : ; < > . A raw dump of the tape in the region about the illegal character allows the user a means to correct the character. A modification to this mode checks the data format on the tape as being one of the two allowed patterns; i.e., the twelve character time tag sequence or the nine character data value sequence. This mode of operation is intended for interactive use.

This program package allows data recovery procedures useful in those cases where a character is incorrectly recorded and/or reproduced. It is also a necessary adjunct to the system provided routines for processing stranger types on the Cyber 70 systems at AFGL and Lowell. The flowchart for ILLCHAR is given in Figure I.5.A and a sample of the program output is given in Figure I.5.B.

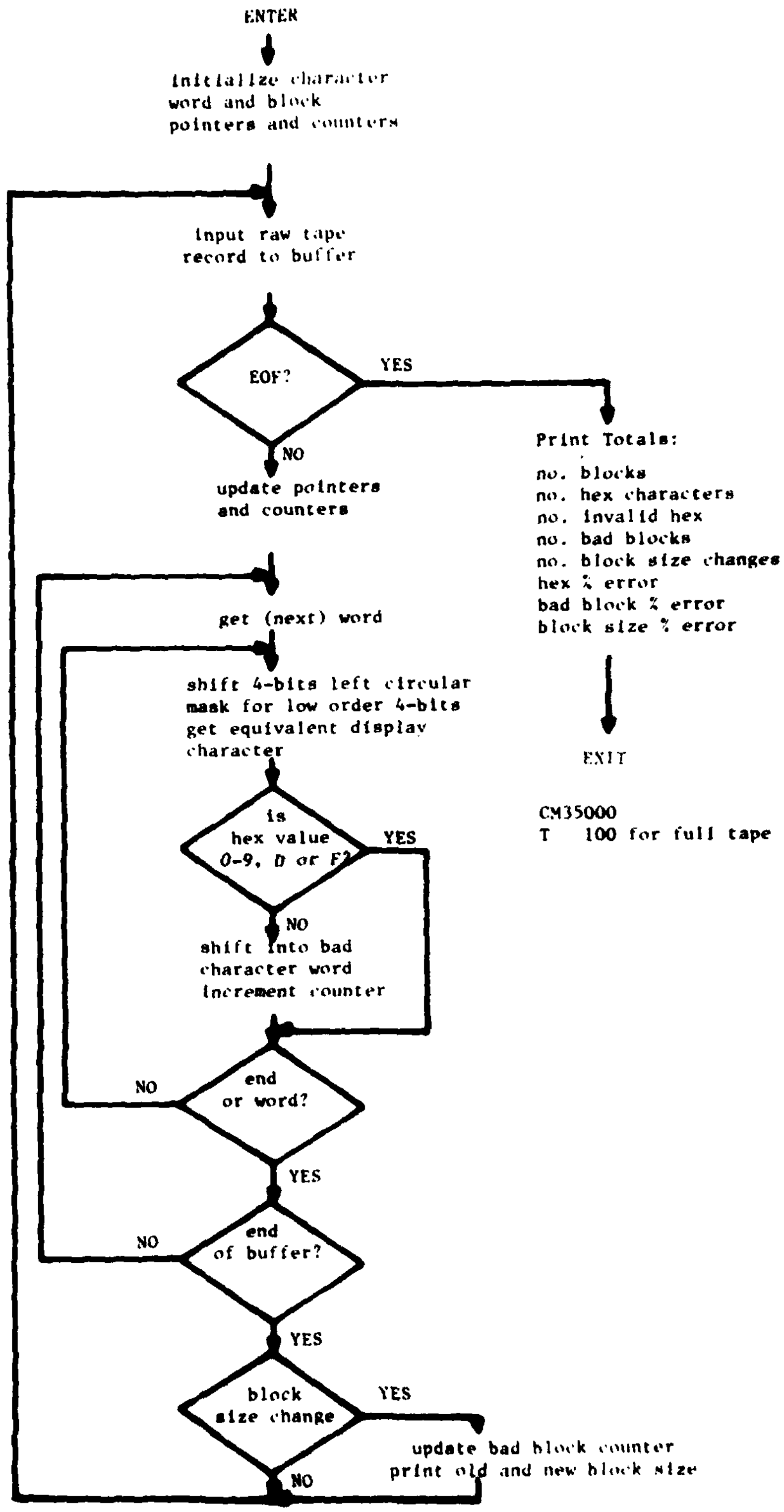


FIGURE I.5.A. FLOWCHART FOR PROGRAM ILLCHAR

TOTAL BLOCKS=120	TOTAL BAD BLOCKS=6	BLOCK PCT. ERROR=5.0
TOTAL NO. CHAR=316710	TOTAL BAD CHAR=21558	PCT. ERROR=6.8
TOTAL BLOCK SIZE CHANGES=90	in 120 BLOCKS	PCT. SIZE ERROR= 75

Figure I.5.B. Sample Output of ILLCHAR

I.6 Raw Tape Program, STRPHEX

The sensor performance and analysis program, STRPHEX, was developed to process raw data tapes or raw data files and can be executed in either the interactive or batch mode of operation. In the interactive mode, the user can request any available option and then the system prompts the user for the necessary responses. The batch mode requires the use of fixed format control cards that perform the requested system options during the job run.

The options available in STRPHEX are:

1. Print selected portions of a raw data tape (file) converting the 6-bit ASCII or hexidecimal data coding to printer-display characters.
2. Generate a 60 line by 120 column line printer output that summarizes the activity of each analog channel called a PROFILE plot.
3. Collect all the data samples recorded on the raw data tape (file) for up to eight selected analog channels over the specified time interval. The data collected is stored in a program array for use by the remaining three options.
4. Produce a signal voltage vs time plot for all the analog data collected in Option 3.
5. Produce a plot that displays the frequency of data points at their respective analog voltage values within the abscissa time intervals.
6. Produce a histogram plot giving the number of data samples at each signal level for the total time interval selected.

Additional options can be added to this system program by the addition of the required linking program to the main program, STRPHEX, and assigning one of the unused option codes. The operational features of each of the active options is given below, and the general STRPHEX flowchart appears in Figure I.6.A.

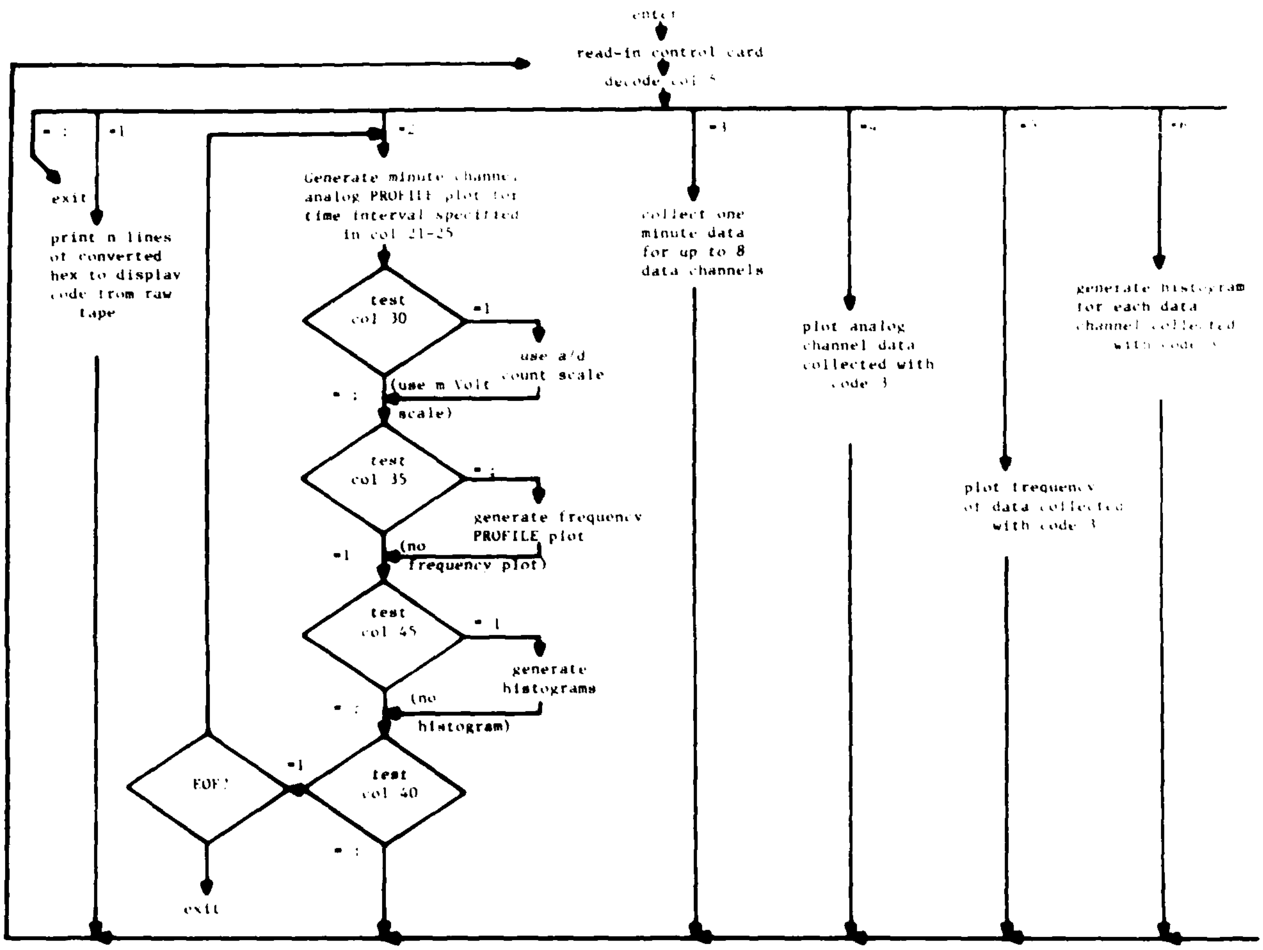


FIGURE I.6.A. FLOWCHART FOR PROGRAM STRPHEX

Option 1, Raw Data DUMP

This option is a utility routine to print out the contents of a data tape (file). The control card allows the data "dump" to start at either the beginning of information, the current tape position, or at a particular time and day on the data tape (file). The user determines the quantity of output and the time duration dumped by specifying the number of lines of output. (See Figure I.6.B).

Option 2, PROFILE Plots

The PROFILE option was developed to meet the need for a compressed form of display of all active sensor channels over time intervals ranging from two hours to over three days. Each of the rows in the plot represents an active sensor channel, and a letter code is used to represent the average of all the one minute data samples collected for the time interval displayed. The conversion for the letter codes representing the user select scale (either millivolts or A/D "counts") is printed below each plot. The time duration represented by each printed letter code is given by the total plot time in minutes divided by 120.

Two useful extremes then are the two hour PROFILE plots and the whole raw tape (file) PROFILE plot. The two hour PROFILES display the sensor outputs on a minute-by minute basis for 120 minutes and yield a detailed analysis method for determining sensor performance. Specifying the total raw tape time duration in minutes yields a single, compressed Profile plot giving all sensor outputs averaged over 30 or 40 minutes per point. This presentation is useful in determinin longer-term sensor performance. Intermediate time intervals such as 4, 8, 12, or 24 hours can also be readily produced, the general theme being that the clustering or scattering of the sensor outputs about various values allows one to asse s performance and establish short and long term data reliability figures.

The control card for this option allows selection of the starting point for

DUMP CHARACTERS PROGRAM

???0771J0C07=00005599<01005869=020059 31=0300 5887=04307528=05306373=06306720
=15006269=16006453=17004000=21312000=23006033<31456595=32456239=33454004=34
12006991=13006163=24324592=25320667=26327383???07710052=11007775<12006967=
???07710 9118=11007753=12006978=13006150=24330583=25334660=26337730???<1=<400
= 744801 62344<018567??<1=<4004<344401==6704801 64744<01858???0771 00150=11
3757???077100213=11007824=12006975=13006147??<1=<4008674<519=<170<9198 2674<=
?<1=<0311=11007822=12006979=13006150??<1=<400<8:04401>10744801 5=:44<01851?
0274=0=982030=811010;0=<110003???<1=<0403=11007813=10006981=13006152????=<4
=988274<<=900174=0=98<43??4<0=98=474<0=985<74<<=900274=0=98<23???<1=<0417=1
8<12006985=13006155???<1=<4011<11007800=12006982=13006155??<1=<40104344401=>
61344<01855??<1=<40140340 00181=7404014467404 8615<<340<01611:0307F00=053 637
9=14004110=15006269=16006579=17004001=21727071=23006033=314675??<1=<4015174
44801 62744<01858:???<1=<40156344401===744801 6<1 006157=24334583=25334481<
38=03005649=04307505=05306369=06707670=07306983<11007765=12006991=13006162=
23006034=31477422=30476004=33474011=34476313=36066118=3706400 2????7100627=1
344801 60:44<01855???0771 0637=11007784=12006978=13006157?4<51= 1034<91=000
5=744<01851??4<51=09 34<91=80474<=1=00174=11=8<9:??<1=<40196744401==83448
05728=0300 58 47=04307512=05306370=06707000=07707168=11007769=12006982=130061
21=23006034=31476507=32476319=33474034=34476325=35076020=37076003??<1=<401<
1==9344801 6=13006152??<1=<401< 344401=>0:44801 60:44<01854??4<51=94474<91=
006992=13006163???07710 0755=11007780=12006989=13006163????7100846=10007780=1
?<1=<0849=11007767<12006975=13006147????7100858=11007788=12006982=13006153=
34040144 7408015<=740<016127430 7516=05306373=06306187=07307190=11007776=120
04001=21327041=23006033=314776:4<91=010:4<=1=00134=11=8<4;4=82500174=<25800
83=25334491=26336147??<1=<40242744401>02744801 64344<01858???07710 0919=110
01 5=744<01851??<1=<4024834<501=24:4<901006 74<=000000000000001000???<1=<4024
756=12006990=13006163??<1=<0826=11007784=12006977=13006149=24334572=25334490
<17??<1=<4024 344001===:44801 5>744<01854???077100939=11007820<12006977=130
1=<40252344401>09344801 5=:44<01851???<1=<0955<11007781=12006968=13006161??
02=24304574=25304500=26304001??077040534 90<115<3494<1140;496<1==83??<1=<40
0<560=25304555=26307664???07710 1100=00007363=01004142=02005220=03005706=043
14004131=15004010=16006734=17004007=21306892=23006035=36034174=37034000???=
480<51593494<51657498<5=497??<1=<40488:490<9155:494<91613498<9=19???0771013
4=:404011043408 0150=???0771 01410<20304570=25319=:498<1<5<3??<1=<40506 3490<
94<649<26307124???077101434=24 3045;494<11923498<1<443???<1=<40550;490<515=:
498<99=43????71 017 02=24334588=25334500=26336747???077101718=243345:494<=124
5666=03005839=04307529=05306371=06306335=07307188=14004127=15004007=160 0693
1???<1=<40608:490<575<25304463=26306543???077101834=243045:494<1115349 8<194

FIGURE I.6.B. RAW DATA TAPE DUMP SAMPLE

the PROFILE plot, specification of the duration of the plot in minutes, the scale to be used in the plot, the optional generation of a histogram for each active data channel, and a PROFILE-type plot giving the number of occurrences of each sensor for the plot abscissa values rather than sensor output values. The options allowed with PROFILE are shown in Figure I.6.A, the STRPHEX flowchart. (See PROFILE Figure I.6.C).

Option 3, Collect Data Routine

The remaining three options utilize a pre-loaded data array that is loaded from the raw data source by the routine, COLLD; i.e., collect data. The control card for this option allows user specified starting time and the duration of the data collection interval in minutes along with the channel numbers (up to eight) for which the data is to be collected. (See Figure I.6.D).

Option 4, Plot Sensor Output

This routine presupposes that COLLD has previously been run to collect the data for the sensor output that is to be plotted. The user can specify the starting time, the time duration of the plot with one or two discrete channels plotted at the top of the display. The plot is automatically scaled based on the minimum and maximum values and allows for the selection of linear or logarithmic scale. (See Figure I.6.E).

Option 5, Plot Sensor Output Frequency Values

As a variation to Option 4, this option produces a plot identical in all respects to Option 4 except that the display characters reflect the time sequence of the data points within the abscissa time increments. It is useful when used with Option 4 to determine the time-ordered sequence of values that are averaged for each point in the sensor output voltage plot. (See Figure I.6.F).

```
DATA PROFILE

END-OF-DATA-FILE AT D/H/M/S=   112    9   57    9

 FROM  D/H/M= 108/ 14/ 49/              TO D/H/M= 112/  9/ 57/

CHANS                                              DATA

MRI1- 00   [illegible]
MRI2- 70   [illegible]
MRI3- 00   [illegible]
MRI4- 00   [illegible]
LTRO- 00   [illegible]
LTRO- 01   [illegible]
NPH1- 30   [illegible]
NPH2- 00   [illegible]
NPH3- 30   [illegible]
VLB1- 00   [illegible]
VLB2- 30   [illegible]
VLB3- 30   [illegible]
LSR1- 00   [illegible]
LSR2- 00   [illegible]
LSR3- 00   [illegible]
LSR4- 03   [illegible]
BPN1- 00   [illegible]
ERN1- 01   [illegible]
BPN1- 02   [illegible]
ERN1- 03   [illegible]
RAIN- 00   [illegible]
ILM1- 00   [illegible]
ILM1- 01   [illegible]
ILM1- 03   [illegible]
ILM2- 00   [illegible]
ILM2- 01   [illegible]
ILM2- 03   [illegible]
ILM3- 00   [illegible]
NEP2- 09   [illegible]
NEP3- 00   [illegible]
NEP4- 08   [illegible]
EPL1- 00   [illegible]
EPL2- 00   [illegible]
EPL2- 01   [illegible]
EPL2- 02   [illegible]
EPL2- 03   [illegible]
EPL2- 04   [illegible]
EPL2- 05   [illegible]
EPL2- 06   [illegible]
EPL2- 07   [illegible]
EPL2- 08   [illegible]
EPL2- 09   [illegible]
BD78- 00   [illegible]
      14.49     22.25      6. 1      13.37     21.19      4.49      12.25      20. 1      3.37     11.1?     18.4?     2.??
                                   ON THE 108 TH DAY.

SCALE FOR PROFILE PLOT (MILIVOLTS)

                                           PRINTED DATA DESIGNATORS

         A   B   C   D   E    F    G    H    I    J    K    L    M    N    O    P    Q    R    S    T    U     +      *
         0  250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000 3250 3500 3750 4000 4250 4500 4750 5000  NEG.   (V.RNG.
```

FIGURE I.6.C. PROFILE OPTION FOR 4 DAY INTERVAL

DATA COLLECTION.	CURVE	CHAN	DISC	POINTS
	1	4	-1	1437
	2	5	0	1437
	3	6	0	1437
	4	7	0	1437
	5	21	0	362
	6	21	1	362
	7	21	2	358
	8	21	3	358

FIGURE I.6.D. SAMPLE DATA COLLECT OUTPUT

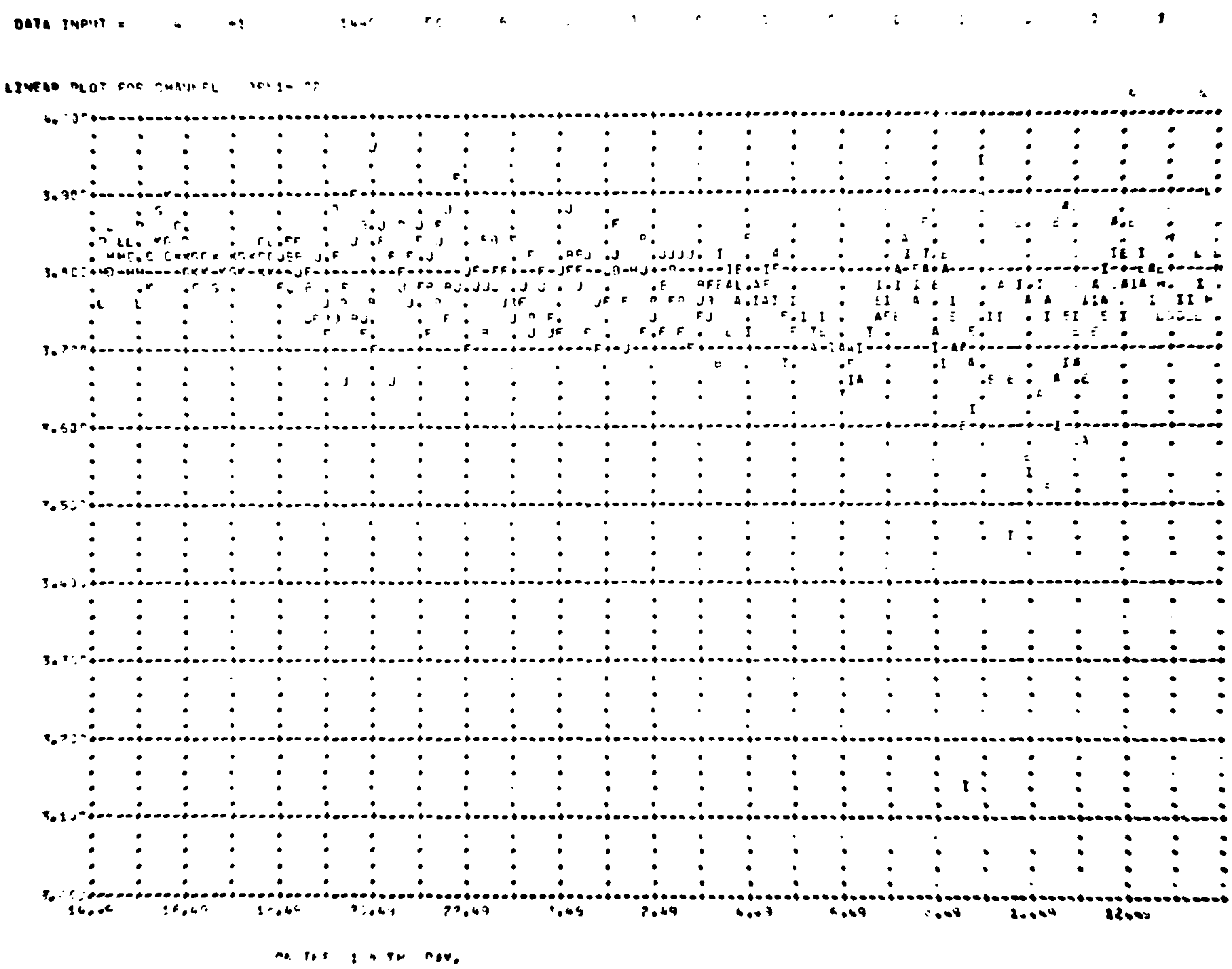


FIGURE I.6.E. PLOT SENSOR OUTPUT SAMPLE,TRANSMISSOMETER DATA FOR 1 DAY

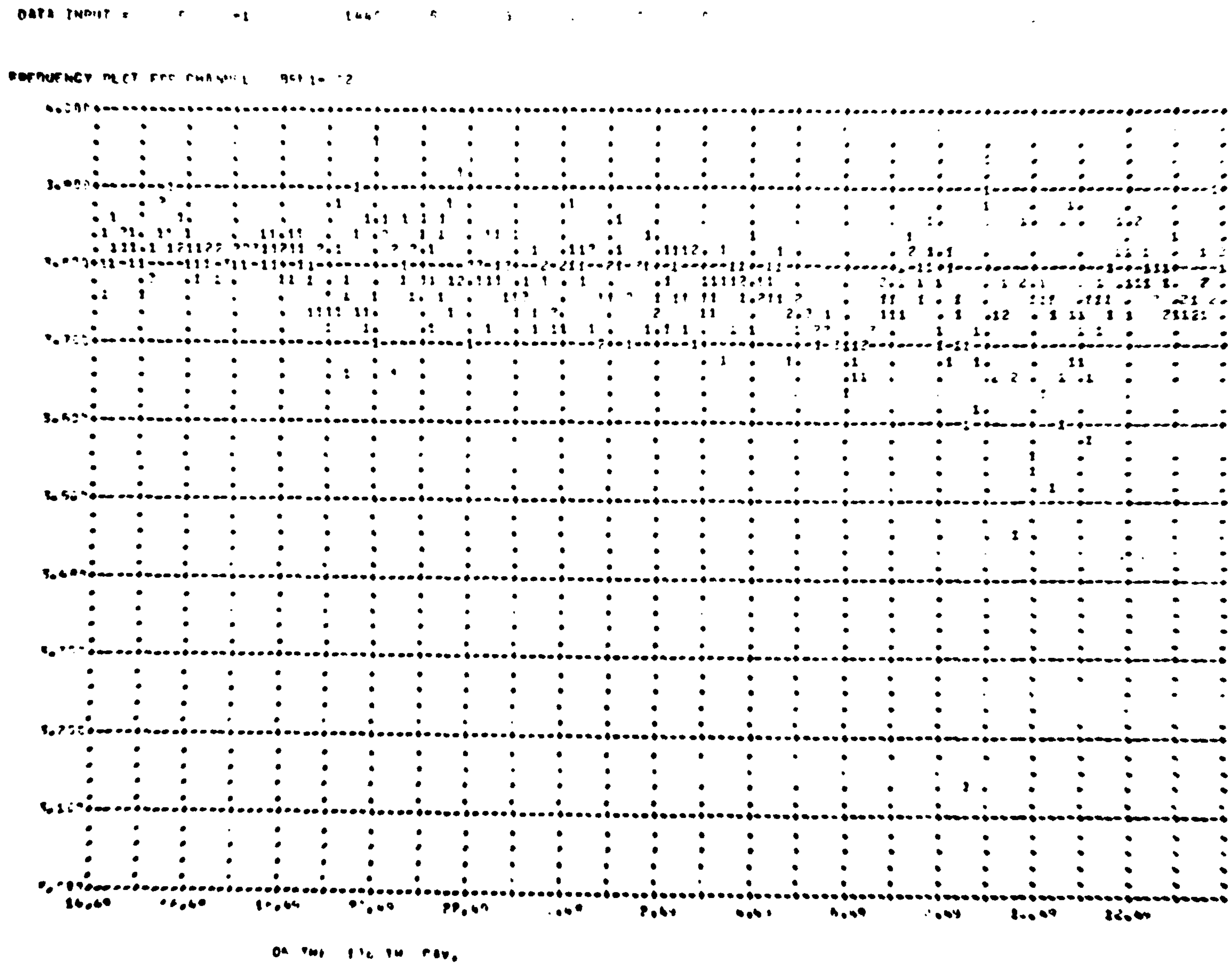


FIGURE I.6.F. FREQUENCY OF OCCURRENCE PLOT, TRANSMISSOMETER DATA FOR 1 DAY

Option 6, Histogram Plotting

With this option, the data collected under Option 3 can be used to produce a histogram display for any or all of the sensor outputs stored in Option 3.

The careful reader will note that the Options 4, 5 and 6 all require the previous use of Option 3 to collect the data into a program array. These routines were designed to be used on the raw data for quick editing and preliminary analysis operations. These options are most useful when used on an interactive terminal in the study of selected sensor outputs over limited time durations. (See Figure I.6.G).

The overall program design of STRPHEX is seen in the subprogram linkage diagram given in Figure 1.6.H, where the re-linking and re-use of a small number of routines allows additional options to be easily developed. An example of this approach is the subroutine AUTOGM, which can be linked into the Option 2 PROFILE plots through the control card and also the ability to "parade" through a data source file with a fixed time increment from the beginning to the end of the information.

While the plots produced in Options 4, 5 and 6 are not in scientific units, the inclusion of the instrument calibration programs in STRPHEX as a user selected feature could be provided if deemed necessary.

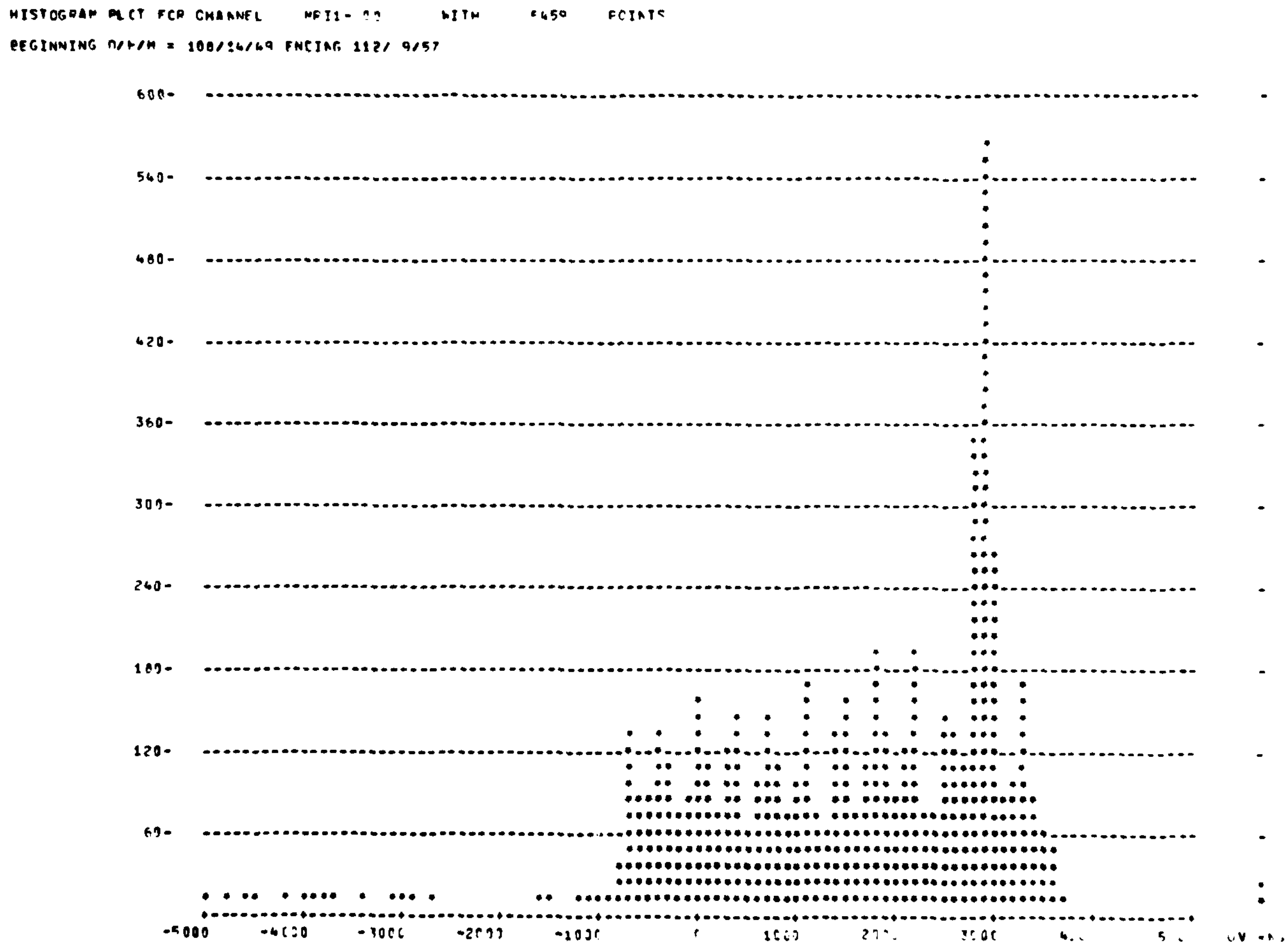


FIGURE I.6.G. HISTOGRAM PLOT FOR 4 DAYS DURATION,SAMPLING NEPHELOMETER DATA

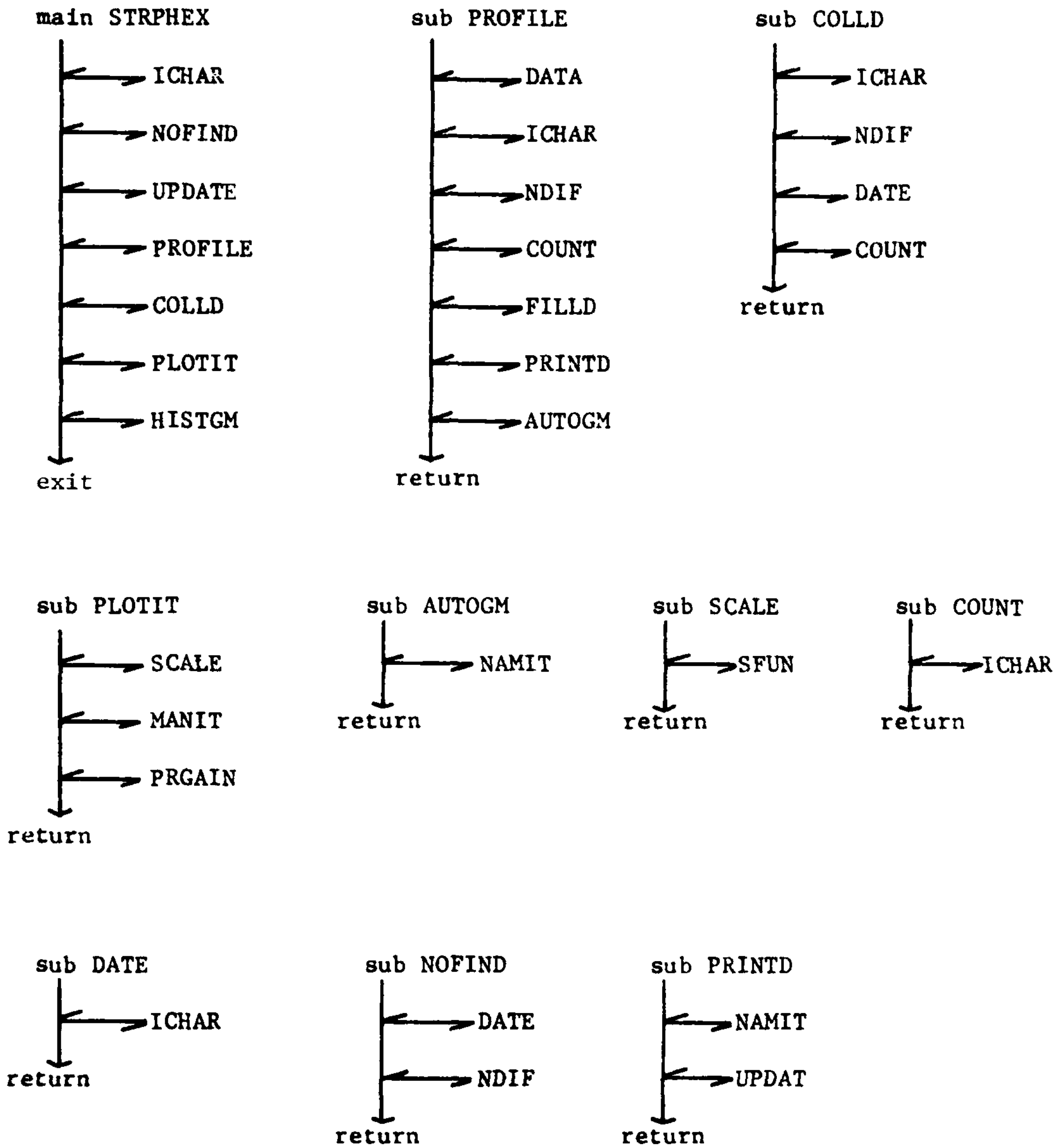


FIGURE I.6.H. STRPHEX Subprogram Linkages

I.7 Utility Program BLOCK

While the data logger system is programmed to produce raw tape records of 3060 hexidecimal characters, records of greater and less lengths are frequently encountered. The tape utility program, BLOCK, was developed to reblock input records of varying lengths into output records of a fixed size. The algorithm used may be likened to two circles, each rotating at a different velocity that transfer tape characters through a storage array. The input raw tape record of tape characters is stored on the periphery of the input circle. The input circle is then indexed to the first character and the record of characters is transferred to the storage array, starting at the next open position in the array. The loading of the tape characters from the input circle to the storage array is interrupted when the storage array has accumulated a fixed number of characters which are then transferred to the output circle. The output circle also interrupts the transfer process when it has received the number of characters determined by the output block size. The fixed block of characters is then transferred from the output circle to the disk-based data file and the process continues. The input circle also interrupts the process when it becomes empty and reads in a new record of raw data to be blocked. The process continues until the end of information mark is detected on the raw data tape files. Character processing is carried out similar to that performed by ILLCHAR, and the program printout indicates the total number of input records read, the total number of output records produced, the total number of input hexidecimal characters, the total number of invalid hex characters and the hex character percent error. This output information is compared to the output of ILLCHAR to determine the reliability of the raw data record blocking process. The flowchart for BLOCK is given in Figure I.7.A.

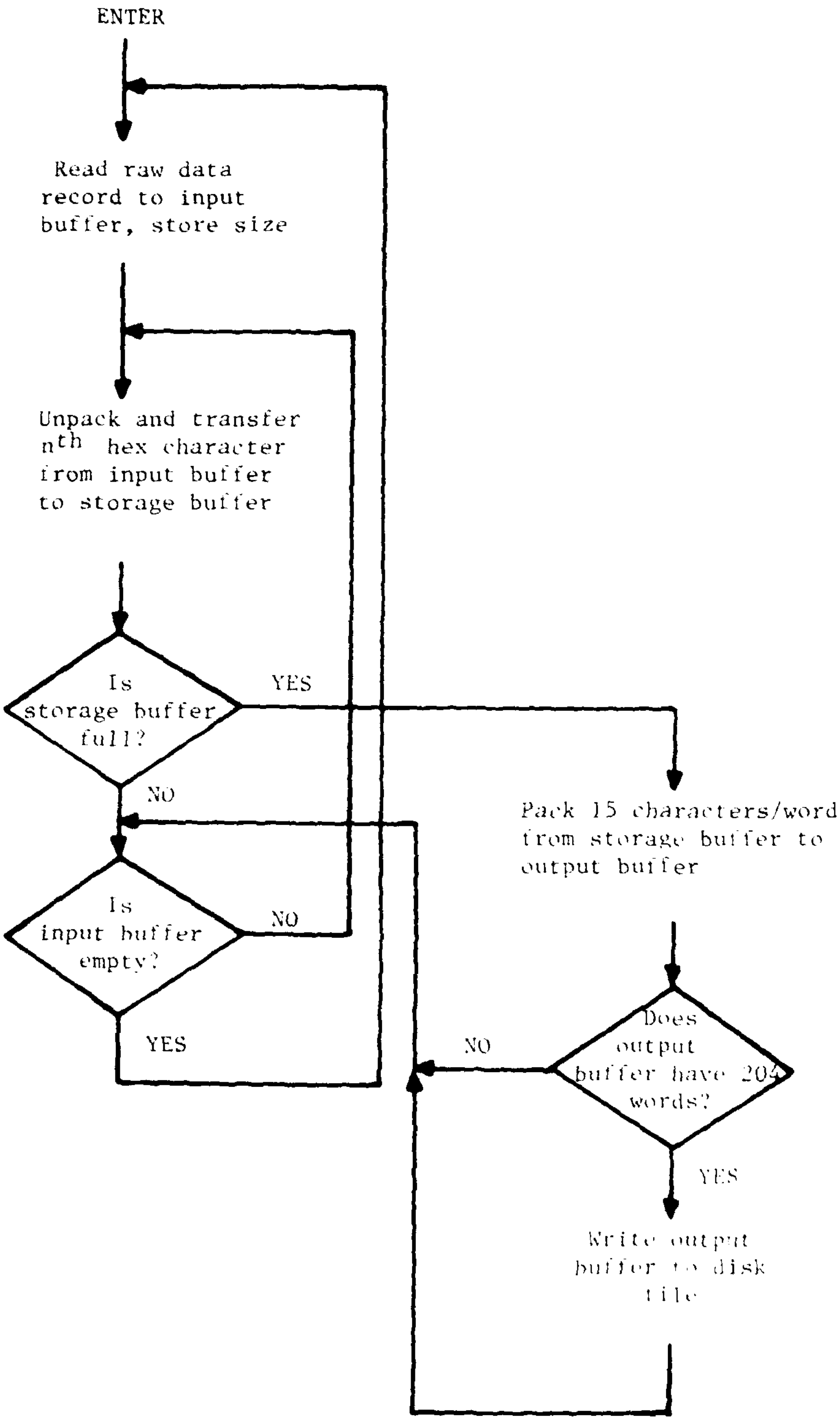


FIGURE 1.7.A. Flowchart for BLOCK.

II. OVERVIEW OF STRIPPING AND OUTPUT PROGRAMS

Figure II.A is an overview of the raw tape stripping program. Ten data files are involved in the program; these are indicated by the double bordered lines in the figure. The data files include the original raw data file described above, three stripped files and their associated directories, the OPA[illegible] date file (ERIK), and two temporary files which are useful in constructing the other files. The various printer outputs which can be generated from each of the files are shown in the figure using parallelograms.

The names of the procedures required for initializing the files, stripping, and generating the outputs are shown with the directed lines in the figure. These names are actually procedure files. A procedure file is a set of system control commands necessary to attach the required files and execute the required programs to perform the procedure. The procedure can then be initiated [illegible] single call statement which executes all the control commands in the [illegible]. In this way the user need not be concerned with the detailed system control [illegible].

The data files involved are now described briefly:

RAW DATA FILE - This is the raw data tape described in section [illegible] permanent file copy of it. In general the data [illegible] for a three to five day period arranged sequentially in time with measurement [illegible] recorded for that time [illegible]. In general the sequential nature of the [illegible] makes it impractical for obtaining [illegible] plots, and special arrays of data. Hence, the data is stripped from the raw data and [illegible] three stripped files [illegible] below.

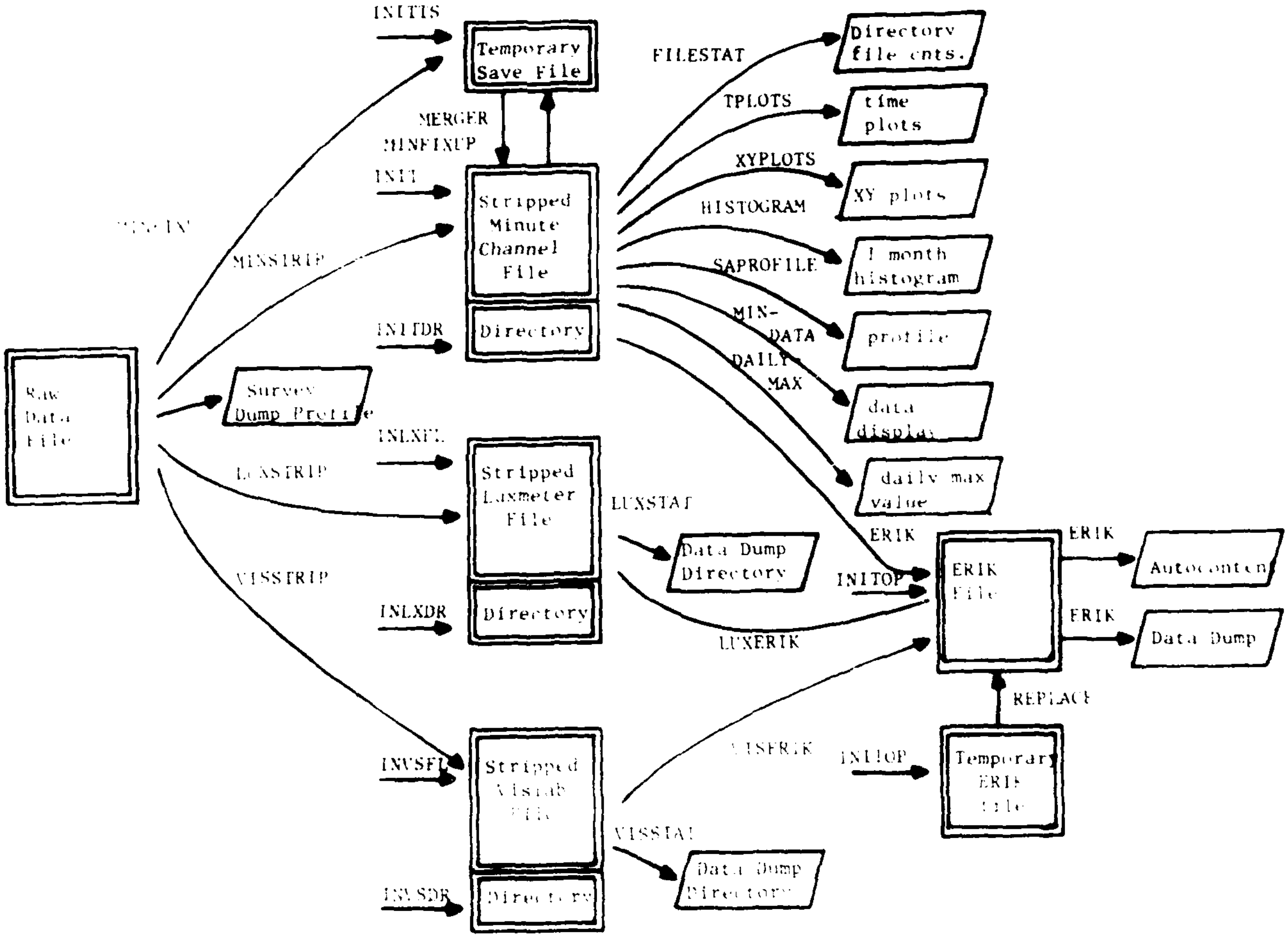


FIGURE II.A. OVERVIEW OF STRIPPING AND OUTPUT PROGRAMS

[illegible] - This file contains the data from the Raw Data [illegible] instruments which have data present at [illegible]

[illegible]

[illegible] FILE - This [illegible]

contains the data stripped from 1 data tape. For months which used more than 10 data tapes (such as April, 1978 and May, 1978), two Luxmeter Files were required. The data entered into the Luxmeter File are the values of [illegible] to the vertical and horizontal channels (in counts) when the direction of the rotating vertical channel corresponds to one of the compass points. Also, the time corresponding to each set of data and the direction in degrees (truncated to an integer) are entered. If the instrument is not rotating, no entries will be made into this file.

STRIPPED LUXMETER DIRECTORY - This contains data for each record in the stripped Luxmeter File. Entries are record number, raw tape number, first and last data time in record, number of data times, and date record was added to file.

STRIPPED VISLAB FILE - This file contains the stripped Variable Path Function Meter (VPFM) data from the Raw Data File. Like the Stripped Luxmeter File, the Vislab File is also for a single month period containing up to 10 records, one for a single data tape. For months with more than 10 data tapes, two Vislab Files were required. Entries are made for each 10 minute period the instrument is recording (normally the first 10 minutes of each hour). Entries include the time of the first data point used for the 10 minute period, the first value, last value, maximum value, minimum value, and number of samples for each of the compass points. Also the filter used for the 10 minute period is entered.

STRIPPED VISLAB DIRECTORY - This contains data for each record in the Stripped Vislab File. Entries are the same as in the Stripped Luxmeter Directory described above.

ERIKFILE - The Erik File (OPAQUE Data Bank) contains values taken from the three stripped files described above. Each file is for a one month period and contains 31 records, one for each day. 85 values are recorded for each hour using the format given in Appendix I: "ERIKFILE/OPAQUE Data Bank Format". Values entered by the programs reported here include station number, date (year, month, day), hour, measurements cycle duration (10 minutes) and instrument data from the stripped arrays for a ten minute period during the hour (before April 12, 1977, 0923 CET for 30 minutes to 40 minutes past the hour; after that date, for the first 10 minutes of the hour). The initialization program for the Erik File initializes all 85 words for each hour; additional information to be input to the file from other sources include comment numbers, Meppen weather data, and quality integers for each measurement.

TEMPORARY ERIKFILE - This file is identical to the Erik File described above. It is useful for modifying a previously created Erik File if, say, the calibration should change for an instrument.

The procedure files and how they fit in the overall program are depicted in the overview Figure II.A. Except for the initialization programs, each has been stored as a permanent file. The initialization programs were not stored to minimize the possibility of accidently reinitializing a partially created data file.

A brief description of the uses of each procedure file follows:

MINSTRIP - is used to study the contents of the Raw Data File and to strip the minute channel data from the Raw Data File to construct the Stripped Minute Channel File and corresponding Directory.

MINFIXUP - is used when it is desirable to use the Temporary Save File in the stripping process.

MERGER - is used when two records for the same half-day must be merged into one record as is required when raw tapes are changed.

FILESTAT - is used to print out a summary of the attached Stripped Minute Channel File and to print out the contents of the attached Stripped Minute Channel Directory.

[illegible] - is used to strip the Luxmeter data from the Raw Data File to construct the Stripped Luxmeter File and corresponding Directory.

LUXSTAT - is used to dump portions of the Stripped Luxmeter File and its Directory.

VISSTRIP - is used to strip the VPFM data from the Raw Data File to construct the Stripped Vislab File and corresponding Directory.

VISSTAT - is used to dump portions of the Stripped Vislab File and its Directory.

TPLOTS - is used to generate time plots from the Stripped Minute Channel File.

XYPLOTS - is used to generate xy plots from the Stripped Minute Channel File.

HISTOGRAM- is used to generate one month histograms from the Stripped Minute Channel File.

SAPROFILE- is used to generate profiles of data contained in the Stripped Minute Channel File.

MINDATA - is used when it is desired to print scientific (calibrated) values from up to 7 specified channels over a specified time range from the attached Stripped Minute Channel File.

DAILYMAX - is used when it is desired to print out the maximum count (hourly maximums) of a selected channel from the attached Stripped Minute Channel File.

ERIK - is used to obtain the required values from the Stripped Minute Channel File to add to the Erik File, to print out a summary of the status of the Erik File, and to dump the contents of the Erik File.

LUXERIK - is used to obtain the required values from the Stripped Luxmeter File to add to the Erik File.

VISERIK - is used to obtain the required values from the Stripped Vislab File to add to the Erik File.

REPLACE - is used to replace all or a portion of a channel of the attached Erik File with the corresponding elements of the attached Temporary Erik File.

INIT - initializes the Stripped Minute Channel File

INITDR - initializes the Stripped Minute Channel Directory

INITTS - initializes the Temporary Save File

INLXFL - initializes the Stripped Luxmeter File

INLXDR - initializes the Stripped Luxmeter Directory

INVSFL - initializes the Stripped Vislab File

INVSDR - initializes the Stripped Vislab Directory

INITOP - initializes the Erik File

Although FORTRAN has library subroutine calls which can add records to an existing disk file when they are created, it has been found to be much safer to initialize the total file before it is filled with data. This is the purpose of the 8 initializing programs just described.

Examples of all the outputs which can be obtained from the data files described above and which are shown in the overview are presented in Figures II.B to II.P. These include:

FIGURE II.B. SURVEY OF RAW DATA FILE SAMPLE (MINSTRIP)

FIGURE II.C. DUMP OF RAW DATA FILE SAMPLE (MINSTRIP)

FIGURE II.D. PROFILE OF RAW DATA FILE SAMPLE (MINSTRIP)

FIGURE II.E. SORTED STRIPPED MINUTE CHANNEL DIRECTORY SAMPLE (FILESTAT)

FIGURE II.F. STRIPPED MINUTE CHANNEL CONTENTS SAMPLE (FILESTAT)

FIGURE II.G. TIME PLOT SAMPLE (TPLOTS)

FIGURE II.H. XY PLOT SAMPLE (XYPLOT)

FIGURE II.I. HISTOGRAM SAMPLE (HISTOGRAM)

FIGURE II.J. PROFILE OF STRIPPED MINUTE DATA SAMPLE (SAPROFILE)

FIGURE II.K. STRIPPED MINUTE CHANNEL DATA DISPLAY (MINDATA)

FIGURE II.L. DAILY MAXIMUM VALUE SAMPLE (DAILYMAX)

FIGURE II.M. STRIPPED LUXMETER DIRECTORY AND DATA DUMP SAMPLE (LUXSTAT)

FIGURE II.N. STRIPPED VISLAB DIRECTORY AND DATA DUMP SAMPLE (VISSTAT)

FIGURE II.O. ERIKFILE CONTENTS SUMMARY SAMPLE (ERIK)

FIGURE II.P. ERIKFILE HOURLY DATA DUMP SAMPLE (ERIK)

```
REWIND
SURVEY,500,10

BLOCK     1      108/14/49/ 4
BLOCK    11      108/15/ 3/41
BLOCK    21      108/15/ 8/38
BLOCK    31      108/15/40/ 8
BLOCK    41      108/16/ 2/37
BLOCK    51      108/16/ 7/35
BLOCK    61      108/16/31/20
BLOCK    71      108/17/ 1/33
BLOCK    81      108/17/ 7/ 2
BLOCK    91      108/17/26/44
BLOCK   101      108/18/ 1/ 0
BLOCK   111      108/18/ 5/58
BLOCK   121      108/18/17/56
BLOCK   131      108/18/59/28
BLOCK   141      108/19/ 4/55
BLOCK   151      108/19/ 9/54
BLOCK   161      108/19/50/40
BLOCK   171      108/20/ 3/52
BLOCK   181      108/20/ 8/50
BLOCK   191      108/20/41/52
BLOCK   201      108/21/ 2/49
BLOCK   211      108/21/ 7/47
BLOCK   221      108/21/33/ 0
BLOCK   231      108/22/ 1/45
BLOCK   241      108/22/ 6/43
BLOCK   251      108/22/24/ 4
BLOCK   261      108/23/ 0/41
BLOCK   271      108/23/ 5/39
BLOCK   281      108/23/15/ 8
BLOCK   291      108/23/56/56
BLOCK   301      109/ 0/ 4/36
BLOCK   311      109/ 0/ 9/34
BLOCK   321      109/ 0/48/ 4
BLOCK   331      109/ 1/ 3/33
BLOCK   341      109/ 1/ 8/31
BLOCK   351      109/ 1/39/ 4
BLOCK   361      109/ 2/ 2/29
BLOCK   371      109/ 2/ 7/27
BLOCK   381      109/ 2/39/12
BLOCK   391      109/ 3/ 1/26
BLOCK   401      109/ 3/ 6/24
BLOCK   411      109/ 3/21/20
BLOCK   421      109/ 4/ 0/22
```

FIGURE II.B. SURVEY OF RAW DATA FILE SAMPLE (MINSTRIP)

The command shown requests printing the first time found in 500 blocks, 10 blocks apart. This is adequate to "survey" the complete RAW DATA FILE. Only the first portion is shown.

```
DUMP,2000
923/170040    01/2133751    1/23006020    /24334547/    25334617/2
6336731/36    076008/370    74002)))10    8144904/24    304548/253
04619/2630    6721)))108    144908/243    04552/2530    4606/26306
714)))1081    44912/2430    4549/25304    612/263066    98)))10814
4916/24304    549/253046    05/2630668    8)))108144    920/243045
54/2530459    9/26306682    )))1081449    24/2430455    0/25304610
/26306669)    ))10814492    8/24304548    /25304598/    26306659))
)108144932    /24304548/    25304591/2    6306649)))    108144936/
24304548/2    5304587/26    306642)))1    08144940/2    4304551/25
304582/263    06636)))10    8144944/24    304547/253    04585/2630
6619)))108    144948/243    04551/2530    4580/26306    615)))1081
44952/2430    4550/25304    581/263066    01)))10814    4956/24304
546/253045    82/2630658    9)))108145    000/000063    28/0100503
0/02005761    /03005906/    04307846/0    5306371/06    306484/073
06983/1400    6132/15006    253/160072    92/1700400    2/21306443
/23006021/    24304546/2    5304577/26    306582/360    84001/3708
4003)))108    145004/243    14544/2531    4580/26316    572)))1081
45008/2431    4547/25314    576/263165    66)))10814    5012/24314
549/253145    75/2631655    7)))108145    016/243145    43/2531458
0/26316541    )))1081450    20/2431454    8/25314577    /26316534)
))10814502    4/24314544    /25314580/    2631652())    )108145028
/24314543/    25314580/2    6316511)))    108145032/    24314544/2
5314578/26    316504)))1    08145036/2    4314547/25    314574/263
16497)))10    8145040/24    314549/253    14573/2631    6487)))108
145044/243    14544/2531    4578/26316    472)))1081    45048/2431
4546/25314    578/263164    61)))10814    5052/24314    545/253145
78/2631645    2)))108145    056/243145    45/2531457    6/26316444
)))1081451    00/0000616    2/01005147    /02005803/    03005914/0
4307845/05    306372/063    06457/0730    6584/14006    118/150062
60/1600725    7/17004001    /21317265/    23006020/2    4314546/25
314572/263    16433/3609    6001/37094    001)))1081    45104/2432
4551/25324    570/263264    28)))10814    5108/24324    549/253245
71/2632641    3)))108145    112/243245    46/2532457    1/26326402
)))1081451    16/2432454    7/25324568    /26326393)    ))10814512
0/24324550    /25324562/    26326389))    )108145124    /24324553/
25324558/2    6326381)))    108145128/    24324553/2    5324557/26
326370)))1    08145132/2    4324552/25    324554/263    26362)))10
8145136/24    324549/253    24557/2632    6347)))108    145140/243
24554/2532    4550/26326    342)))1081    45144/2432    4553/25324
548/263263    34)))10814    5148/24324    555/253245    45/2632632
```

FIGURE II.C. DUMP OF RAW DATA FILE SAMPLE (MINSTRIP)

The command requests printing 2000 characters following the pointer location from the raw data file. Time data (9 decimal digits) is preceded by three right parentheses; channel data (8 decimal digits) is preceded by a slash.

```
INSTANT,2 $ PROFILE,50

                PROFILE   BLOCK =     1   POINT =     1

                0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 2 2 2 2 2 3 3 3 3 3 3
      TIME      0 1 2 3 4 5 6 7 1 2 3 4 5 6 7 1 3 4 5 6 1 2 3 4 6 7

108/14/50/00    1-5-8-9 9 1 2 4 * * * 0 1 6-0 2 0-2-2 2 * * * *-0-0
108/14/55/00    6-1-6-9 9 1 2 4 * * * 1 1 5-0 6 0-2-2 8 * * * * 0-0
108/15/00/00    3-4-8-9 9 1 2 4 7 4 0 2 1 4-0 7 0-2-2 4 3 0 0 7 0-0
108/15/05/00    6-1-6-9 9 1 1 4 8 4 0 8 1 4-0 7 0-2-2 0 4 0 0 7 0-0
108/15/10/00    6-1-6-9 9 1 1 4 * * * 1 1 4 0 2 0-2-2 5 * * * *-0-0
108/15/15/00    0-5-8-9 9 1 1 4 * * * 0 1 5-0 6 0-2-2 2 * * * * 0-0
108/15/20/00    5-1-7-9 9 1 1 4 * * * 0 1 6-0 7 0-2-2 7 * * * * 0-0
108/15/25/00    2-4-8-9 9 1 2 4 * * * 0 1 7-0 7 0-2-2 3 * * * * 0-0
108/15/30/00    7-0-6-8 9 1 3 4 * * * 0 1 7-0 2 0-2-2 8 * * * * 0-0
108/15/35/00    3-3-7-9 9 1 3 4 * * * 0 1 8-0 6 0-2-3 5 * * * *-0-0
108/15/40/00    0-5-8-9 9 1 2 4 * * *-0 1 9-0 7 0-2-2 1 * * * * 0-0
108/15/45/00    5-2-7-9 9 1 2 4 * * *-0 1 9-0 7 0-2-2 6 * * * * 0-0
108/15/50/00    1-4-8-9 9 1 2 4 * * * 0 1 X-0 6 0-2-3 2 * * * * 0-0
108/15/55/00    6-0-6-8 9 1 3 4 * * * 0 1 X-0 7 0-2-2 8 * * * * 0-0
108/16/00/00    3-3-8-9 9 1 3 4 8 4 0 0 1 X-0 7 0-2-3 4 7 0 0 7 0-0
108/16/05/00    6-1-6-8 9 1 3 4 7 4 0 0 1 9-0 2 0-2-2 0 1 7 0 7 0-0
108/16/10/00    6-1-6-8 9 1 3 4 * * *-0 1 8-0 6 0-2-2 5 * * * * 0-0
108/16/15/00    1-5-8-9 9 1 3 4 * * * 0 1 8-0 7 0-2-3 2 * * * * 0-0
108/16/20/00    6-1-6-8 8 1 3 4 * * * 0 1 7-0 7 0-2-2 7 * * * *-0-0
108/16/25/00    2-4-8-9 9 1 2 4 * * * 0 1 6-0 2 0-2-3 3 * * * * 0-0
108/16/30/00   -9-9-9-9 9 1 3 4 * * * 0 1 5-0 6 0-2-2 8 * * * * 0-0
108/16/35/00    3-2-7-8 9 1 1 4 * * * 1 1 5-0 7 0-2-2 5 * * * * 0-0
108/16/40/00    0-5-8-9 8 1 3 4 * * * 6 1 4-0 7 0-2-2 1 * * * * 0-0
108/16/45/00    5-1-6-8 8 1 2 4 * * * 0 1 4 1 2 0-2-2 6 * * * * 0-0
108/16/50/00    1-4-8-9 8 1 2 4 * * * 0 1 5 0 6 0-2-2 2 * * * *-0-0
108/16/55/00    6-0-6-8 9 1 2 4 * * * 0 1 6-0 7 0-2-2 8 * * * * 0-0
108/17/00/00    3-3-7-9 9 1 3 4 7 4 0 0 1 6-0 7 0-2-3 4 5 0 0 7 0-0
108/17/05/00    6-1-6-8 9 1 2 4 8 4 0 0 1 7-0 2 0-2-2 0 4 0-0 7-0-0
108/17/10/00    6-1-6-8 9 X 2 4 * * * 0 1 8-0 6 0-2-0 * * * * * 0-0
108/17/15/00    0-5-8-9 9 1 1 4 * * *-0 1 8-0 7 0-2-2 2 * * * * 0-0
108/17/20/00    6-1-6-8 9 1 1 4 * * *-0 1 9-0 7 0-2-2 7 * * * * 0-0
108/17/25/00    2-4-8-9 9 1 1 4 * * *-0 1 X-0 2 0-2-2 3 * * * *-0-0
108/17/30/00   -5-8-9-9 9 1 1 4 * * * 7 1 X-0 6 0-2-2-3 * * * * 0-0
108/17/35/00    3-3-7-8 X 1 1 4 * * * 0 1 X-0 7 0-0 * 5 * * * *-0-0
108/17/40/00    0-5-8-9 9 1 1 4 * * *-0 1 9-0 7 0-2-2 1 * * * *-0-0
108/17/45/00    5-1-6-8 9 1 1 4 * * * 0 1 8-0 2 0-2-2 6 * * * * 0-0
108/17/50/00    1-4-8-9 9 1 0 4 * * *-0 1 8-0 6 0-2-2 2 * * * *-0-0
108/17/55/00    6-0-5-8 9 1 0 4 * * * 0 1 7-0 7 0-2-1 8 * * * * 0-0
108/18/00/00    3-3-7 X 9 1 0 4 9 4 0 0 1 5 * 7 0-2-2 4 1 1 0 7 0-0
108/18/05/00    6-1-6-8 9 1 0 4 5 4 0 0 1 6-0 2 0-2-2 0 8 0 0 7-0-0
108/18/10/00    6-1-6-8 9 1 0 4 * * * 1 1 5-0 6 0-2-1 5 * * * *-0-0
108/18/15/00    0-5-8-9 9 1 0 4 * * * 3 1 4-0 7 0-2-2 2 * * * * 0-0
108/18/20/00    6-1-6-8 9 1 0 4 * * * 2 1 4 0 7 0-2-1 7 * * * *-0-0
108/18/25/00    2-4-7-9 9 1 4 3 * * * 0 1 5 0 2 0-2-1 3 * * * *-0-0
108/18/30/00   -1-6-8-9 9 1 3 3 * * * 0 1 5-0 6 0-1-1 0 * * * *-0-0
108/18/35/00    3-2-7-8 9 1 2 3 * * * 0 1 6-0 7 0-1-1 5 * * * *-0-0
108/18/40/00    0-5-8-9 9 1 2 3 * * * 0 1 7-0 7 0-1-1 1 * * * *-0-0
108/18/45/00    5-1-6-8 9 1 1 3 * * * 0 1 9-0 6 0-1-0 6 * * * * 0-0
108/18/50/00    1-4-8-9 9 1 1 3 * * * 0 1 8-0 7 0-1-1 2 * * * *-0-0
108/18/55/00    6-0-6-8 9 1 0 3 * * * 0 1 9-0 7 0-1-0 8 * * * *-0-0
```

FIGURE II.D. PROFILE OF RAW DATA FILE SAMPLE (MINSTRIP)

The commands shown request listing an indication of the data contained in the RAW DATA FILE for 50 times at 5 minute intervals. The integers printed are an indication of the values recorded. This number is calculated by taking the integer part of the absolute value of the count divided by 200. A negative sign indicates the counts were recorded as negative, an X indicates a value out of range, and an asterisk indicates no value present.

SORTED DIRECTORY

DAY- 59	HALF-1	RECORD- 1	TAPE- 1	ENTERED	4/11/	78
DAY- 59	HALF-2	RECORD- 2	TAPE- 1	ENTERED	4/11/	78
DAY- 60	HALF-1	RECORD- 3	TAPE- 1	ENTERED	4/11/	78
DAY- 60	HALF-2	RECORD- 4	TAPE- 1	ENTERED	4/11/	78
DAY- 61	HALF-1	RECORD- 5	TAPE- 1	ENTERED	4/11/	78
DAY- 61	HALF-2	RECORD- 7	TAPE-51	ENTERED	6/26/	78
DAY- 62	HALF-1	RECORD- 9	TAPE-51	ENTERED	6/26/	78
DAY- 62	HALF-2	RECORD- 10	TAPE-51	ENTERED	6/26/	78
DAY- 63	HALF-1	RECORD- 27	TAPE-51	ENTERED	6/26/	78
DAY- 63	HALF-2	RECORD- 60	TAPE-51	ENTERED	6/26/	78
DAY- 64	HALF-1	RECORD- 52	TAPE-51	ENTERED	6/26/	78
DAY- 64	HALF-2	RECORD- 59	TAPE-51	ENTERED	6/26/	78
DAY- 65	HALF-2	RECORD- 28	TAPE-51	ENTERED	6/26/	78
DAY- 65	HALF-1	RECORD- 45	TAPE-53	ENTERED	7/ 3/	78
DAY- 66	HALF-1	RECORD- 49	TAPE-51	ENTERED	6/26/	78
DAY- 66	HALF-2	RECORD- 16	TAPE-53	ENTERED	7/ 3/	78
DAY- 67	HALF-1	RECORD- 6	TAPE- 1	ENTERED	4/12/	78
DAY- 67	HALF-2	RECORD- 44	TAPE-53	ENTERED	7/ 3/	78
DAY- 68	HALF-1	RECORD- 8	TAPE- 1	ENTERED	4/12/	78
DAY- 68	HALF-2	RECORD- 43	TAPE-53	ENTERED	7/ 3/	78
DAY- 69	HALF-1	RECORD- 48	TAPE-51	ENTERED	6/26/	78
DAY- 69	HALF-2	RECORD- 42	TAPE-53	ENTERED	7/ 3/	78
DAY- 70	HALF-1	RECORD- 11	TAPE- 1	ENTERED	4/12/	78
DAY- 70	HALF-2	RECORD- 12	TAPE- 1	ENTERED	4/12/	78
DAY- 71	HALF-1	RECORD- 13	TAPE- 1	ENTERED	4/12/	78
DAY- 71	HALF-2	RECORD- 14	TAPE- 1	ENTERED	4/12/	78
DAY- 72	HALF-1	RECORD- 32	TAPE- 1	ENTERED	4/13/	78
DAY- 72	HALF-2	RECORD- 33	TAPE- 1	ENTERED	4/13/	78
DAY- 73	HALF-1	RECORD- 17	TAPE- 1	ENTERED	4/12/	78
DAY- 73	HALF-2	RECORD- 18	TAPE- 1	ENTERED	4/12/	78
DAY- 74	HALF-2	RECORD- 50	TAPE-51	ENTERED	6/26/	78
DAY- 74	HALF-1	RECORD- 47	TAPE-51	ENTERED	6/26/	78
DAY- 75	HALF-1	RECORD- 19	TAPE- 1	ENTERED	4/20/	78
DAY- 75	HALF-2	RECORD- 20	TAPE- 1	ENTERED	4/20/	78
DAY- 76	HALF-1	RECORD- 21	TAPE- 1	ENTERED	4/20/	78
DAY- 76	HALF-2	RECORD- 22	TAPE- 1	ENTERED	4/20/	78
DAY- 77	HALF-2	RECORD- 61	TAPE-50	ENTERED	6/ 7/	78
DAY- 77	HALF-1	RECORD- 15	TAPE-50	ENTERED	6/23/	78
DAY- 78	HALF-1	RECORD- 23	TAPE-50	ENTERED	6/23/	78
DAY- 78	HALF-2	RECORD- 24	TAPE-50	ENTERED	6/23/	78
DAY- 79	HALF-1	RECORD- 25	TAPE-50	ENTERED	6/23/	78
DAY- 79	HALF-2	RECORD- 26	TAPE-50	ENTERED	6/23/	78
DAY- 80	HALF-1	RECORD- 51	TAPE-51	ENTERED	6/26/	78
DAY- 80	HALF-2	RECORD- 46	TAPE-51	ENTERED	6/26/	78
DAY- 81	HALF-1	RECORD- 53	TAPE-51	ENTERED	6/ 7/	78
DAY- 81	HALF-2	RECORD- 54	TAPE-51	ENTERED	6/ 7/	78
DAY- 82	HALF-1	RECORD- 55	TAPE-51	ENTERED	6/ 7/	78
DAY- 82	HALF-2	RECORD- 56	TAPE-51	ENTERED	6/ 7/	78
DAY- 83	HALF-1	RECORD- 57	TAPE-51	ENTERED	6/ 7/	78
DAY- 83	HALF-2	RECORD- 58	TAPE-51	ENTERED	6/ 7/	78
DAY- 84	HALF-1	RECORD- 29	TAPE-52	ENTERED	6/26/	78
DAY- 84	HALF-2	RECORD- 30	TAPE-52	ENTERED	6/26/	78
DAY- 85	HALF-1	RECORD- 34	TAPE-52	ENTERED	6/26/	78
DAY- 85	HALF-2	RECORD- 35	TAPE-52	ENTERED	6/26/	78
DAY- 86	HALF-1	RECORD- 31	TAPE-52	ENTERED	6/26/	78
DAY- 86	HALF-2	RECORD- 37	TAPE-52	ENTERED	6/26/	78
DAY- 87	HALF-1	RECORD- 38	TAPE-52	ENTERED	6/26/	78
DAY- 87	HALF-2	RECORD- 36	TAPE-52	ENTERED	6/26/	78
DAY- 88	HALF-1	RECORD- 39	TAPE-53	ENTERED	6/26/	78
DAY- 88	HALF-2	RECORD- 40	TAPE-53	ENTERED	6/26/	78
DAY- 89	HALF-1	RECORD- 41	TAPE-53	ENTERED	6/26/	78

FIGURE II.E. SORTED STRIPPED MINUTE CHANNEL DIRECTORY SAMPLE
([illegible])

This is a chronological listing of the STRIPPED MINUTE CHANNEL DIRECTORY for March, 197[illegible].

```
RECORD -  3       DAY -  60       HALF - 1
GOT RECORD -  3  STRIPPED DATA FOR DAY -    60


                  11111111112222222222333333333344444444445555555555
        012345678901234567890123456789012345678901234567890123456789


60/10   666666666644444444444444444444444444444444444444444444444444
60/11   666666666644444444444444444444444444444444444444444444444444
60/12   666666666644444444444444444444444444444444444444444444444444
60/13   666366666644444444444444444444444444444444444444440041101414
60/14   221465242214104113044143100000000000000000000000000000000000
 0/ 0   000000062111100303430040411114001004104300430414110133314000
60/16   621225362200421414014004112110000100114143111441124314110333
60/17   205202565311404214011410001004114103404411000411340144004111
60/18   332232226201141111140014002300000050000030100000000000000000
 0/ 0   000000000000000000000000000000000000041441111014341004111041
60/20   321223212120011000000000410000000000000000000000000000000000
 0/ 0   000006666644444444444444444444444444444444444444444444444444

RECORD -  4       DAY -  60       HALF - 2
GOT RECORD -  4  STRIPPED DATA FOR DAY - 1060


                  11111111112222222222333333333344444444445555555555
        012345678901234567890123456789012345678901234567890123456789


60/22   666666666644444444444444444414444444444444444444444444444444
60/23   666666666644444444444414444444444444444444444444444444444444
61/ 0   666666666644444444444444444444444444444444444444444444444444
61/ 1   666666666644444444444444444444444444444444444444444444444444
61/ 2   666666336644444444444444444444444444444444444444444444444444
61/ 3   666656666644444444444444444444444444444444444444444444444444
61/ 4   666666666644444444444444444444444444444444444444444444444444
61/ 5   666666666644444444444444444444444444444444444444444444444444
61/ 6   666666666644444444444444444444444444444444444444414444444444
61/ 7   666666666644444444444444444444444444444444444444444444444444
61/ 8   666666666644444444444444444444444444414444444414444444444444
61/ 9   666666666644444444444444444444444444444444444444444444444444
```

FIGURE II.F. STRIPPED MINUTE CHANNEL CONTENTS SAMPLE (FILESTAT)

This sample shows an indication of the contents of two records from the attached STRIPPED MINUTE CHANNEL file in chronological order. Each number on the array is an indication of the number of samples stored in the particular minute specified. This number is calculated by adding 3 to the number of samples, dividing by 4, and taking the integer part of the result. Notice that more data is stored for the first [illegible] minutes of the hour.

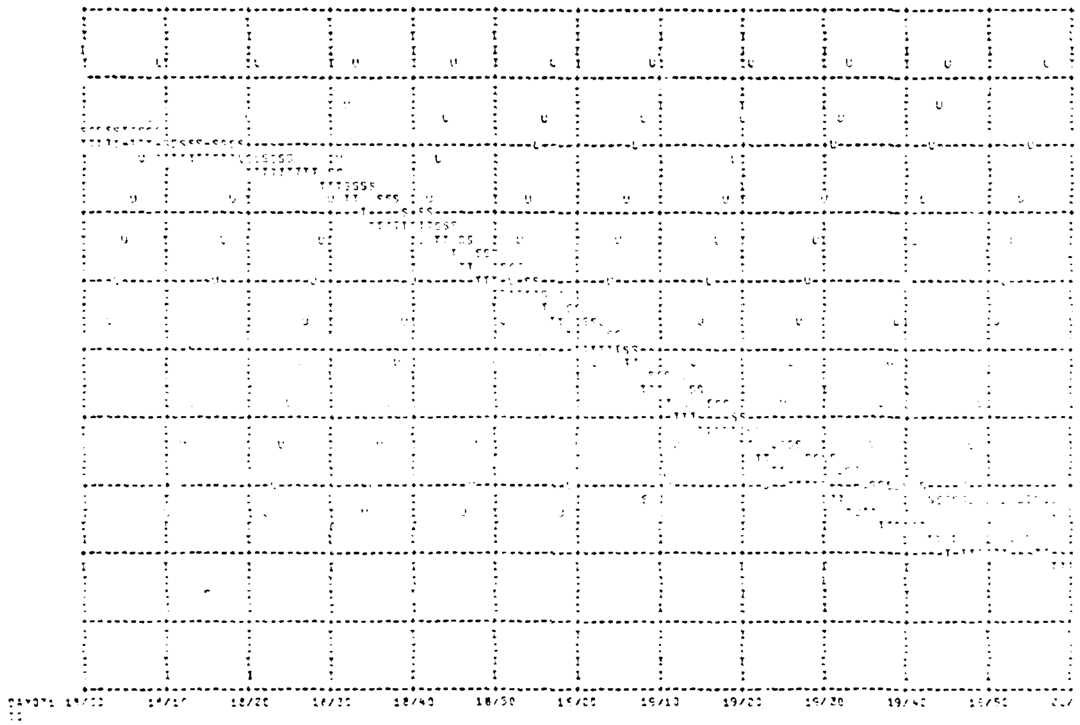
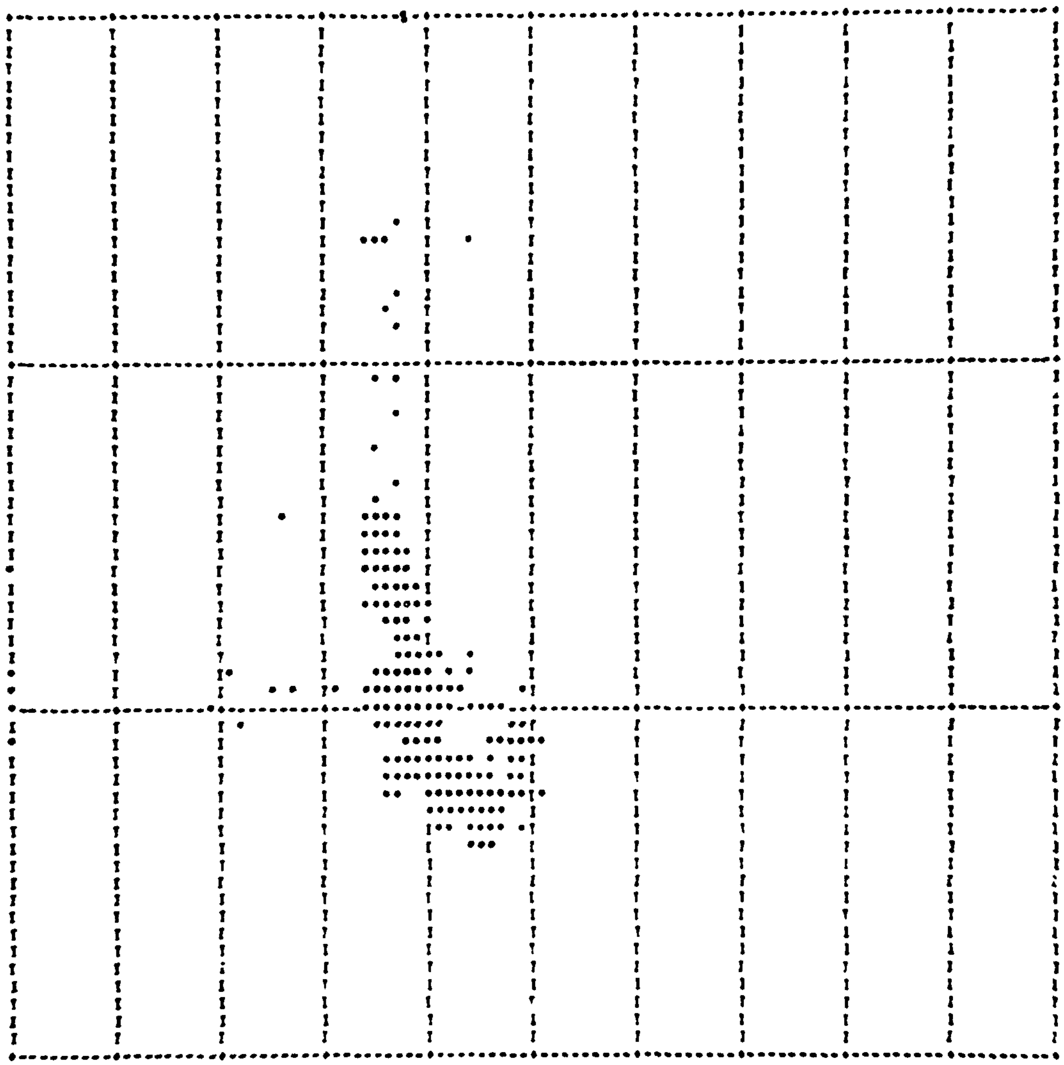


FIGURE II.G. TIME PLOT SAMPLE (TPLOTS)

The plot shown is the ILLUMINOMETER Horizontal channel (Channel 24), Vertical channel (Channel 25), and Azimuth (Channel 26) data in scientific units over a two hour period around nightfall.



SCATTER DIAGRAM - ELTRO VS BARNES (3-5 MICRONS)
CHANNEL 219 (*) BOTTOM = 0. TOP = 100. EACH DIVISION = 10.0
CHANNEL 4 (*) LOG SCALE, BOTTOM = 10**(-1) TOP = 10**(2)

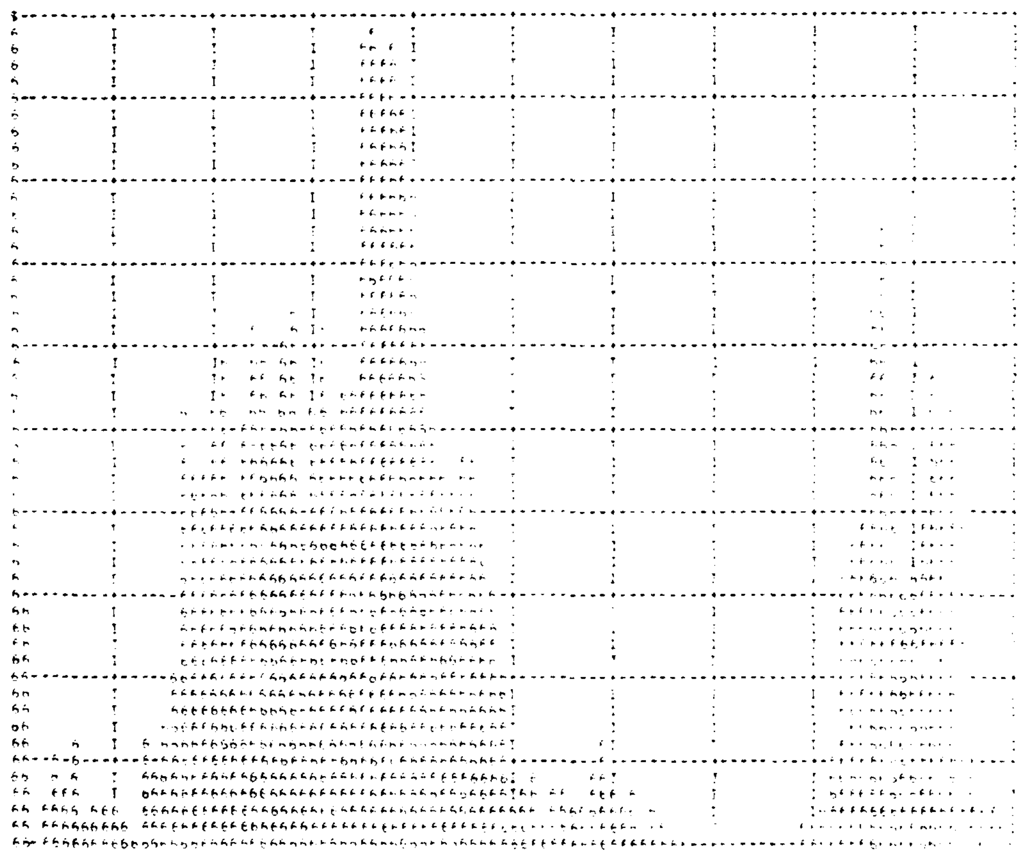
FIGURE II.H. XY PLOT SAMPLE (XYPLOT)

The plot shown is a scatter diagram over a 10 hour period of the Eltro vs Barnes transmissometer with 3-5 micron filter. The scaling values have been superimposed on the plot.

HISTOGRAM FOR CHANNEL 21[illegible]
MIN = 3. MAX = 1[illegible].
NUMBER OF BINS = 1[illegible]
NUMBER OF POINTS USED = 56[illegible]
NUMBER OF POINTS OUT OF RANGE = 2[illegible]

DISTRIBUTION

38[illegible]	51	[illegible]	13	21	1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	8	5	[illegible]	1[illegible]	[illegible]	[illegible]	[illegible]	7	[illegible]
92	101	69	59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
92	112	89	96	[illegible]	[illegible]	16[illegible]	[illegible]	[illegible]	[illegible]
134	1[illegible]	87	80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	1[illegible]	18	8	1[illegible]	1[illegible]	11	1[illegible]	1[illegible]	[illegible]
16	11	14	6	11	[illegible]	[illegible]	[illegible]	[illegible]	
5	4	2	2	[illegible]	1	2	2	[illegible]	[illegible]
8	12	21	58	[illegible]	[illegible]	11[illegible]	[illegible]	[illegible]	[illegible]
58	69	98	84	92	[illegible]	[illegible]	[illegible]	1[illegible]	9
4									



BARNES T-5 (FEC) MARCH, 197[illegible]

FIGURE II.1. HISTOGRAM SAMPLE (HISTOGRAM

This histogram is for the Barnes instrument (with [illegible] micron filter) for the whole month of March, 197[illegible]. It has been generated using [illegible] for this time period. The horizontal axis is transmittance [illegible] the vertical axis is arbitrary.

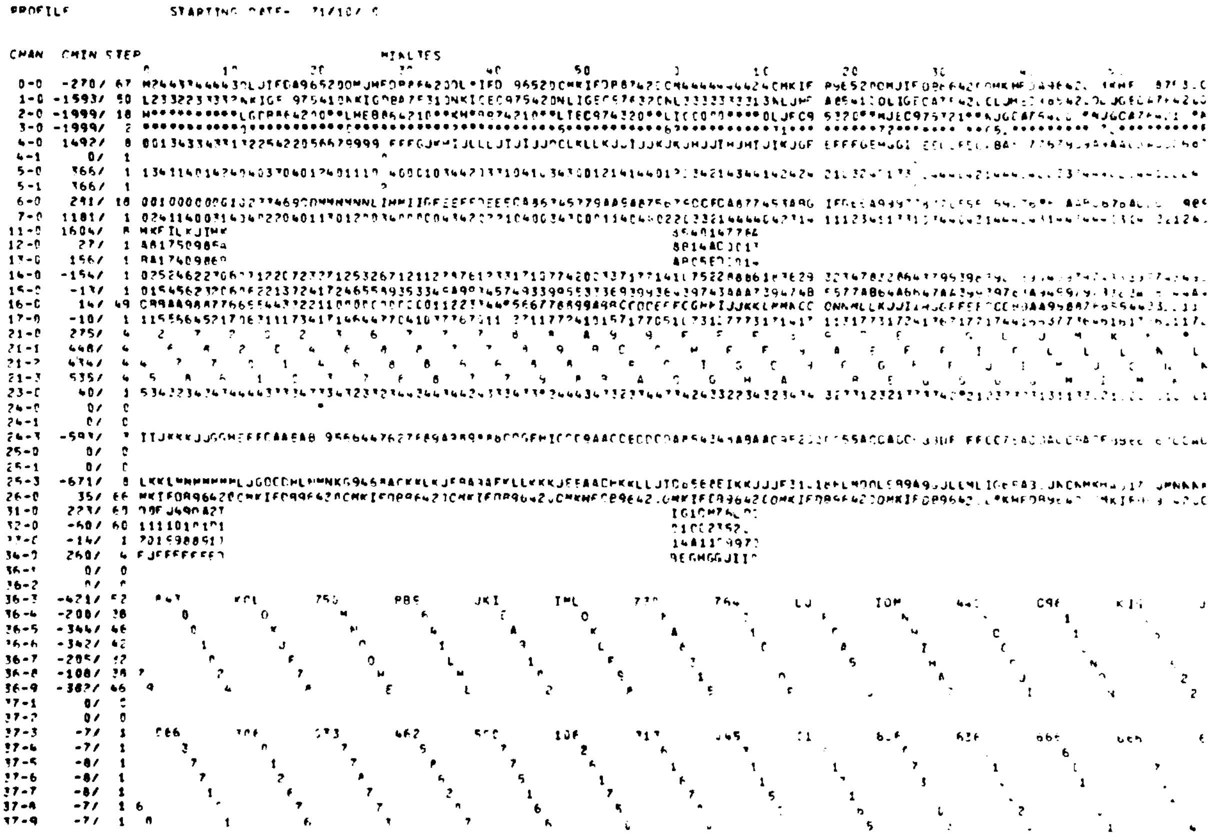


FIGURE II.J. PROFILE OF STRIPPED MINUTE DATA SAMPLE (SAPROFILE)

The profile shown gives an indication of the data contained in the STRIPPED MINUTE CHANNEL FILE for a two hour period in March. This profile has the same form as that mentioned in Section I.; that profile however is generated from the RAW DATA FILE.

			24			25			26
71/11/ 0	1	33	9.29E+03	1	33	1.18E+04	1	33	7.72E+01
71/11/ 1	1	30	9.98E+03	1	30	1.87E+04	1	30	1.09E+02
71/11/ 2	1	31	1.12E+04	1	31	2.70E+04	1	31	1.38E+02
71/11/ 3	1	32	1.14E+04	1	32	2.47E+04	1	32	1.71E+02
71/11/ 4	1	33	1.18E+04	1	33	2.02E+04	1	33	2.01E+02
71/11/ 5	1	30	1.16E+04	1	30	1.13E+04	1	30	2.32E+02
71/11/ 6	1	31	9.98E+03	1	31	7.82E+03	1	31	2.61E+02
71/11/ 7	1	32	9.40E+03	1	32	6.90E+03	1	32	2.92E+02
71/11/ 8	1	33	8.96E+03	1	33	6.71E+03	1	33	3.22E+02
71/11/ 9	1	30	9.29E+03	1	30	7.23E+03	1	30	3.56E+02
71/11/10	1	31	9.18E+03	1	31	7.30E+03	1	31	2.67E+01
71/11/11	1	32	8.69E+03	1	32	7.37E+03	1	32	4.41E+01
71/11/12	1	33	9.51E+03	1	33	1.04E+04	1	33	7.70E+01
71/11/13	1	30	1.11E+04	1	30	3.30E+04	1	30	1.08E+02
71/11/14	1	31	1.22E+04	1	31	4.37E+04	1	31	1.40E+02
71/11/15	1	32	1.35E+04	1	32	4.95E+04	1	32	1.70E+02
71/11/16	1	30	1.31E+04	1	30	4.13E+04	1	30	2.03E+02
71/11/17	1	30	1.31E+04	1	30	1.90E+04	1	30	2.32E+02
71/11/18	1	31	1.31E+04	1	31	8.62E+03	1	31	2.63E+02
71/11/19	1	32	1.11E+04	1	32	6.29E+03	1	32	2.92E+02
71/11/20	1	33	1.12E+04	1	33	5.92E+03	1	33	3.24E+02
71/11/21	1	30	9.29E+03	1	30	5.22E+03	1	30	3.53E+02
71/11/22	1	31	8.69E+03	1	31	5.26E+03	1	31	2.48E+01
71/11/23	1	32	8.60E+03	1	32	6.41E+03	1	32	4.46E+01
71/11/24	1	33	9.40E+03	1	33	1.08E+04	1	33	7.70E+01
71/11/25	1	30	8.43E+03	1	30	1.46E+04	1	30	1.07E+02
71/11/26	1	31	8.78E+03	1	31	1.73E+04	1	31	1.40E+02
71/11/27	1	32	8.26E+03	1	32	1.56E+04	1	32	1.69E+02
71/11/28	1	33	8.96E+03	1	33	1.73E+04	1	33	2.01E+02
71/11/29	1	30	8.87E+03	1	30	9.51E+03	1	30	2.32E+02
71/11/30	1	31	8.35E+03	1	31	7.51E+03	1	31	2.62E+02
71/11/31	1	32	8.02E+03	1	32	6.41E+03	1	32	2.92E+02
71/11/32	9	99	9.00E+99	1	33	6.23E+03	1	33	3.23E+02
71/11/33	1	30	7.85E+03	1	30	6.02E+03	1	30	3.53E+02
71/11/34	1	31	8.02E+03	1	31	6.41E+03	1	31	2.51E+01
71/11/35	1	32	8.78E+03	1	32	7.73E+03	1	32	4.64E+01
71/11/36	1	33	8.60E+03	1	33	9.31E+03	8	88	8.00E+99
71/11/37	1	30	1.03E+04	1	30	2.43E+04	1	30	1.09E+02
71/11/38	1	31	9.98E+03	1	31	1.50E+04	1	31	1.40E+02
71/11/39	1	32	9.40E+03	1	32	1.63E+04	1	32	1.71E+02
71/11/40	1	33	8.60E+03	1	33	1.41E+04	1	33	2.01E+02
71/11/41	1	30	8.43E+03	1	30	1.12E+04	1	30	2.31E+02
71/11/42	1	31	9.29E+03	1	31	7.51E+03	1	31	2.62E+02
71/11/43	1	32	8.78E+03	1	32	5.63E+03	1	32	2.92E+02
71/11/44	1	33	8.69E+03	1	33	5.00E+03	1	33	3.22E+02
71/11/45	1	30	9.07E+03	1	30	5.35E+03	1	30	3.56E+02
71/11/46	1	31	9.18E+03	1	31	5.77E+03	1	31	2.63E+01
71/11/47	1	32	8.78E+03	1	32	6.84E+03	1	32	4.62E+01
71/11/48	1	33	7.93E+03	1	33	8.72E+03	1	33	7.66E+01
71/11/49	1	30	9.07E+03	1	30	1.65E+04	1	30	1.09E+02
71/11/50	1	31	9.07E+03	1	31	1.76E+04	1	31	1.38E+02
71/11/51	1	32	1.06E+04	1	32	4.08E+04	1	32	1.70E+02
71/11/52	1	33	1.08E+04	1	33	2.16E+04	1	33	2.00E+02
71/11/53	1	30	1.10E+04	1	30	2.08E+04	1	30	2.32E+02
71/11/54	1	31	1.08E+04	1	31	7.23E+03	1	31	2.61E+02
71/11/55	1	32	1.05E+04	1	32	6.02E+03	1	32	2.94E+02
71/11/56	1	33	8.69E+03	1	33	5.49E+03	1	33	3.24E+02
71/11/57	1	30	8.60E+03	1	30	5.35E+03	1	30	3.56E+02
71/11/58	1	31	9.29E+03	1	31	5.39E+03	1	31	2.53E+01
71/11 59	1	32	8.69E+03	1	32	6.65E+03	1	32	4.54E+01

MINUTE CHANNEL LISTING COMPLETE
DON

FIGURE II.K. STRIPPED MINUTE CHANNEL DATA DISPLAY (MINDATA)

This array is a printout of the contents of the ILLUMINOMETER data (Channels 24, 25, and 26) for a 60 minute period in March, 197[illegible]. For each channel [illegible] is the value in scientific units with a 2 digit discrete value and a single integer representing the validity of the calibrated data. For the validity integer: 1 indicates data ok, 2 - physical variable out of range, [illegible] - no calibration data exists, 8 - data invalid, and 9 - data not present.

```
DAY -  75     NO VALID DATA FOUND
DAY -  75     MAX COUNT -  579      TIME -  75/11/13
DAY -  75     MAX COUNT -  566      TIME -  75/12/ 3
DAY -  75     MAX COUNT -  556      TIME -  75/13/43

DAY -  76     MAX COUNT -  613      TIME -  76/10/25
DAY -  76     MAX COUNT -  696      TIME -  76/11/38
DAY -  76     MAX COUNT -  674      TIME -  76/12/26
DAY -  76     MAX COUNT -  604      TIME -  76/13/ 5

DAY -  77     MAX COUNT -  666      TIME -  77/10/15
DAY -  77     MAX COUNT -  664      TIME -  77/11/13
DAY -  77     MAX COUNT -  664      TIME -  77/12/15
DAY -  77     MAX COUNT -  650      TIME -  77/13/ 2

DAY -  78     MAX COUNT -  643      TIME -  78/10/12
DAY -  78     MAX COUNT -  505      TIME -  78/11/56
DAY -  78     MAX COUNT -  617      TIME -  78/12/ 1
DAY -  78     MAX COUNT -  590      TIME -  78/13/55

DAY -  79     NO VALID DATA FOUND
DAY -  79     MAX COUNT -  653      TIME -  79/11/25
DAY -  79     MAX COUNT -  639      TIME -  79/12/ 2
DAY -  79     MAX COUNT -  643      TIME -  79/13/27

DAY -  80     NO VALID DATA FOUND
DAY -  80     NO VALID DATA FOUND
DAY -  80     NO VALID DATA FOUND
DAY -  80     NO VALID DATA FOUND

DAY -  81     MAX COUNT -  493      TIME -  81/10/36
DAY -  81     MAX COUNT -  507      TIME -  81/11/43
DAY -  81     MAX COUNT -  525      TIME -  81/12/30
DAY -  81     MAX COUNT -  498      TIME -  81/14/ 0

DAY -  82     MAX COUNT -  404      TIME -  82/10/35
DAY -  82     MAX COUNT -  441      TIME -  82/11/36
DAY -  82     MAX COUNT -  512      TIME -  82/12/51
DAY -  82     MAX COUNT -  523      TIME -  82/13/50
```

FIGURE II.L. DAILY MAXIMUM VALUE SAMPLE (DAILYMAX)

This shows the maximum count reached by the LUXMETER instrument for 4 hours around noontime on 8 consecutive days in March, 1977. This data is useful for checking long-term instrument drift.

DIRECTORY $ GET,4 $ DUMP,1,30 $ DONE

DIRECTORY

RECORD-	1	TAPE-47	67/10/34/59	TO	0/ 0/ 0/ 0	ENTERED	4/27/	78
RECORD-	2	TAPE-49	75/11/ 9/ 2	TO	79/ 3/20/34	ENTERED	4/27/	78
RECORD-	3	TAPE-46	59/10/ 0/ 0	TO	0/ 0/ 0/ 0	ENTERED	4/27/	78
RECORD-	4	TAPE-48	70/10/18/13	TO	74/ 9/42/20	ENTERED	4/28/	78
RECORD-	5	TAPE-53	88/ 9/59/ 0	TO	89/14/ 1/36	ENTERED	6/ 7/	78
RECORD-	6	TAPE-50	77/10/ 0/ 7	TO	80/ 6/ 5/38	ENTERED	6/ 8/	78
RECORD-	7	TAPE-52	84/10/30/ 0	TO	88/ 9/44/30	ENTERED	6/ 8/	78
RECORD-	8	TAPE-51	81/10/36/ 0	TO	84/ 9/44/36	ENTERED	6/ 8/	78

GOT RECORD - 4 START DAY - 70/10/21/ 8

70/10/21/ 8	6085268	3100000545	3100000441	359
70/10/24/24	6085464	3000000557	3000000559	90
70/10/27/20	6085640	3300000560	3300000555	181
70/10/30/16	6085816	3200000563	3200000463	271
70/10/33/12	6085992	3100000554	3100000452	0
70/10/36/24	6086184	3000000553	3000000557	90
70/10/39/16	6086356	3300000533	3300000517	179
70/10/42/12	6086532	3200000531	3200000476	270
70/10/45/ 8	6086708	3100000551	3100000472	0
70/10/48/28	6086908	3000000574	3000000563	90
70/10/51/20	6087080	3300000570	3300000566	179
70/10/54/16	6087256	3200000574	3200000510	270
70/10/57/ 8	6087428	3100000557	3100000502	0
70/11/ 0/24	6087624	3000000561	3000000549	89
70/11/ 3/20	6087800	3300000555	3300000539	180
70/11/ 6/16	6087976	3200000547	3200000514	270
70/11/ 9/ 8	6088148	3100000555	3100000504	0
70/11/12/24	6088344	3000000561	3000000559	90
70/11/15/20	6088520	3300000575	3300000585	179
70/11/18/12	6088692	3200000565	3200000526	270
70/11/21/12	6088872	3100000569	3100000515	0
70/11/24/24	6089064	3000000565	3000000536	89
70/11/27/20	6089240	3300000559	3300000568	181
70/11/33/ 8	6089588	3100000546	3100000502	0
70/11/36/24	6089784	3000000566	3000000560	90
70/11/39/20	6089960	3300000567	3300000559	[illegible]
70/11/45/ 8	6090308	3100000541	3100000534	0
70/11/48/28	6090508	3000000582	3000000508	90
70/11/51/16	6090676	3300000555	3300000555	179
70/11/54/16	6090856	3200000554	3200000517	270

FIGURE II.M. STRIPPED LUXMETER DIRECTORY AND DATA DUMP SAMPLE (LUXSTAT)

The printout shows the directory and partial contents for the March, 1977, STRIPPED LUXMETER FILE. The contents dump indicates the time (in days, hours, minutes, seconds), the time in terms of number of seconds from the beginning of the year, the contents of horizontal and vertical ILLUMINOMETER channels, and the azimuth in degrees.

```
DIRECTORY

 RECORD-  1  TAPE- 1     59/10/ 0/ 0  TO   61/18/19/14  ENTERED  4/13/  78
 RECORD-  2  TAPE- 1      0/ 0/ 0/ 0  TO    0/ 0/ 0/ 0  ENTERED  4/20/  78
 RECORD-  3  TAPE- 1     59/10/ 0/ 0  TO   61/18/19/14  ENTERED  4/13/  78
 RECORD-  4  TAPE-49     75/11/ 9/ 2  TO   77/ 0/ 0/34  ENTERED  4/25/  78
 RECORD-  5  TAPE-48     70/10/18/13  TO   74/ 9/43/ 0  ENTERED  4/25/  78
 RECORD-  6  TAPE-47     67/10/34/59  TO   70/ 8/38/40  ENTERED  4/25/  78
 RECORD-  7  TAPE-53     88/ 9/59/ 0  TO   92/13/34/ 0  ENTERED  6/ 7/  78
 RECORD-  8  TAPE-52     84/10/30/ 0  TO   90/ 4/40/ 0  ENTERED  6/ 8/  78
 RECORD-  9  TAPE-50     77/10/ 0/ 7  TO   80/ 6/ 7/27  ENTERED  6/ 6/  78
 RECORD- 10  TAPE-51     81/10/36/ 0  TO   84/ 9/44/52  ENTERED  6/ 6/  78

 GOT RECORD -  5   START DAY -  70/13/ 2/18

  70/13/ 2/18
       1797          1797          1797          1797          1
          0             0             0             0          0
          0             0             0             0          0
          0             0             0             0          0
        158
  71/ 7/ 1/54
       1784          1777          1784          1777          2
          0             0             0             0          0
          0             0             0             0          0
          0             0             0             0          0
        162
  71/ 9/ 5/16
       1676          1740          1740          1676          2
          0             0             0             0          0
          0             0             0             0          0
          0             0             0             0          0
        168
  71/10/ 5/44
       1775          1775          1775          1775          1
          0             0             0             0          0
          0             0             0             0          0
          0             0             0             0          0
        165
  71/11/ 5/10
       1653          1623          1653          1623          2
          0             0             0             0          0
          0             0             0             0          0
          0             0             0             0          0
        160
  71/12/ 2/ 7
       1658          1658          1658          1658          1
          0             0             0             0          0
          0             0             0             0          0
          0             0             0             0          0
        168
  72/ 0/ 1/ 0
       1763          1758          1763          1758          2
          0             0             0             0          0
          0             0             0             0          0
          0             0             0             0          0
        158
```

FIGURE II.N. STRIPPED VISLAB DIRECTORY AND DATA DUMP SAMPLE (VISSTAT)

The printout shows the directory and partial contents for the March, 1977, STRIPPED VISLAB FILE. For each time are the 21 data values discussed in Section II.3.1.

```
           1111111111222222222233333333334444444444555555555566666666667777777777888888
           0123456789012345678901234567890123456789012345678901234567890123456789012345

770301  0  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  1  0-----XXXXX--XXX0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  2  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  3  0-----XXXXX-----0000X-XXX00000000-------X0XXXXXXX000000000000000000000000000
770301  4  0-----XXXXX-----0000-XXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  5  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  6  0-----XXXXX--XXX0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  7  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  8  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301  9  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301 10  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301 11  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301 12  0-XXXXXXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301 13  0XXXXXXXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301 14  0000000000000000000000000000000000000000000000000000000000000000000000000000
770301 15  0-XXXX-XXXX-----0000-XXXX00000000-------0-XXXXX00000000000000000000000000000
770301 16  0-XXXX-XXXX--XXX0000-XXXX00000000-------0XXX-X-00000000000000000000000000000
770301 17  0XXXXX-XXXX-----0000-XXXX00000000-------0XXXXXX00000000000000000000000000000
770301 18  0--XXX--XXX--XXX0000--XXX00000000-------0---X--00000000000000000000000000000
770301 19  0-XXXX-XXXX--XXX0000-XXXX00000000-------0X-XX--00000000000000000000000000000
770301 20  0000000000000000000000000000000000000000000000000000000000000000000000000000
770301 21  0--XXXXXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301 22  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770301 23  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000


           1111111111222222222233333333334444444444555555555566666666667777777777888888
           0123456789012345678901234567890123456789012345678901234567890123456789012345

770302  0  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  1  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  2  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  3  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  4  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  5  0--XXXXXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  6  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  7  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  8  0-----XXXXX--XXX0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302  9  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 10  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 11  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 12  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 13  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 14  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 15  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 16  0-----XXXXX-----0000XXXXX00000000-------0XXXXXXX000000000000000000000000000
770302 17  0-----XXXXX-----0000XXXXX00000000-------X0XXXXXXX000000000000000000000000000
770302 18  0000000000000000000000000000000000000000000000000000000000000000000000000000
770302 19  0000000000000000000000000000000000000000000000000000000000000000000000000000
770302 20  0000000000000000000000000000000000000000000000000000000000000000000000000000
770302 21  0000000000000000000000000000000000000000000000000000000000000000000000000000
770302 22  0000000000000000000000000000000000000000000000000000000000000000000000000000
770302 23  0000000000000000000000000000000000000000000000000000000000000000000000000000
```

FIGURE II.0. ERIKFILE CONTENTS SUMMARY SAMPLE (ERIK)

The contents of the partial ERIKFILE for March 1 and 2, 1977, is indicated. The status of data for each of the entries from element 10 to element 85 is represented by an X, 0, or -. An X indicates data has been entered; an 0 indicates nothing entered yet; a - indicates that the file which should have generated the values has been processed but the data was either invalid or not present.

STATION - 71

DATE - 770301 HOUR - 0 DURATION OF MEASUREMENT CYCLE - 10

COMMENTS -

5	0
6	0
7	0
8	0
9	0
10 SEH	0

11	SSREG	-9.00E+99	34	NV	1.00E+01	56	TX	4.04E+01
12	SSFIN	-9.00E+99	35	FFREG	-1.00E+30	57	TA	2.96E+01
13	SSMAX	-9.00E+99	36	FFFIN	-1.00E+30	58	DT.5	-1.00E+30
14	SSMIN	-9.00E+99	37	FFMAX	-1.00E+30	59	A	-1.00E+30
15	NV	-9.00E+99	38	FFMIN	-1.00E+30	60	B	-1.00E+30
16	EGREG	6.73E-02	39	NV	-1.00E+30	61	C	-1.00E+30
17	EGFIN	9.12E-02	40	FSREG	-1.00E+30	62	D	-1.00E+30
18	EGMAX	1.03E-01	41	FWREG	-1.00E+30	63	E	-1.00E+30
19	EGMIN	6.73E-02	42	FNREG	-1.00E+30	64	F	-1.00E+30
20	NV	1.00E+01	43	F01	-9.00E+99	65	G	-1.00E+30
21	FLREG	-9.00E+99	44	F02	-9.00E+99	66	H	-1.00E+30
22	FLFIN	-9.00E+99	45	F03	-9.00E+99	67	I	-1.00E+30
23	FLMAX	-9.00E+99	46	F04	-9.00E+99	68	M	-1.00E+30
24	FLMIN	-9.00E+99	47	F05	-9.00E+99	69	N	-1.00E+30
25	NV	-9.00E+99	48	F06	-9.00E+99	70	FF	-1.00E+30
26	EVN	-1.00E+30	49	F07	-9.00E+99	71	D2F2	-1.00E+30
27	EVE	-1.00E+30	50	F08	9.78E+01	72	F2F2	-1.00E+30
28	EVS	-1.00E+30	51	F09	-1.00E+30	73	PPP	-1.00E+30
29	EVW	-1.00E+30	52	F10	6.59E+01	74	TTT	-1.00E+30
30	LPREG	7.17E-05	53	T1	3.06E+01	75	TDB	-1.00E+30
31	LPFIN	5.47E-05	54	T2	4.59E+01	76	PPP	-1.00E+30
32	LPMAX	9.28E-05	55	T3	3.99E+01	77	F	-1.00E+30
33	LPMIN	7.64E-05						

78	MPIQ	9999
79	FLTRQ	9999
80	LUVQ	999999999
81	NPQ	9999
82	VISLQ	9999999
83	EPPLQ	9999999999
84	BAPNQ	99999
85		0

FIGURE II.P. ERIKFILE HOURLY DATA DUMP SAMPLE (ERIK)

The values stored in the partial ERIKFILE for hour 0 of March 1, 1977, are shown. The entry -9.00E+99 indicates that the file which should have generated that value has been processed, but the data was either invalid or not present. The entry -1.00E+30 indicates data has not been entered yet. Elements 78 to 84 indicates the data quality (initialized to 9's), and 85 is a spare data word.

II.1. MINUTE CHANNEL STRIP PROGRAM

The Minute Channel Strip Program (MINSTRIP) is used to study the contents of the Raw Data File and to strip minute channel data from it to construct the Stripped Minute Channel File and its directory. Items discussed here are the buffer input algorithms, the stripped array file, and directory structures, and the Minute Channel Strip Program capabilities.

II.1.1 BUFFER INPUT ROUTINES

The buffer input routines are routines by which the blocks of data from the Raw Data File are read in to form the character array (KH) from which the time and channel data is stripped.

There are two different algorithms; one for initializing the character array at the beginning of processing or when a command is issued which requires jumping a number of blocks, and one for continuously moving ahead during the stripping process. These are shown in Figures II.1.A and II.1.B.

Initializing the character array, KH, is done in 6 steps as diagrammed in Figure II.1.A. Notice that the character array contains a complete block of data plus a portion of the next block. This overlap is so that the character array can continuously yield data to the stripper. The raw data blocks are read into an intermediate buffer (BUFF) using the FORTRAN BUFFER IN statement, and BUFF is then decoded to form the character array, KH.

The technique for continuously moving ahead during normal processing is shown in Figure II.1.B. Here also 6 steps are necessary for the advancement.

II.1.2 STRIPPED MINUTE CHANNEL DATA & FILE STRUCTURES

The stripped minute channel data is stored in a single file containing up to 62 half-day records. Each file is for a one month period. Each half-day record requires 12240 central memory words and thus was a good compromise

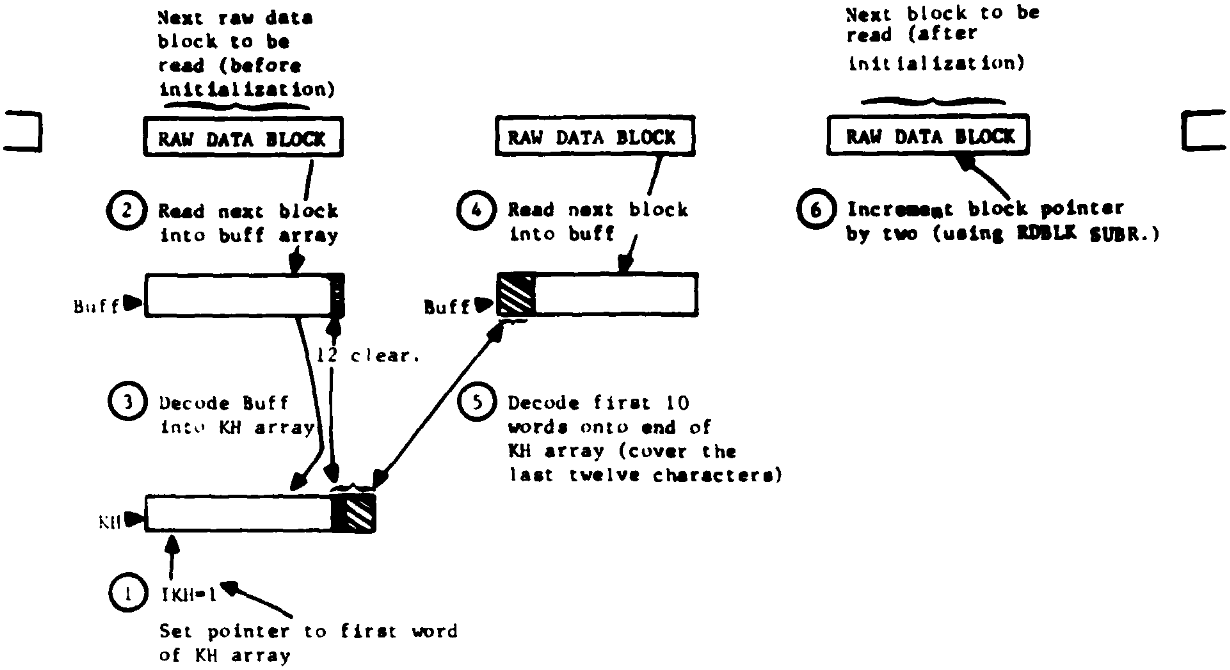


FIGURE II.1.A. CHARACTER ARRAY INITIALIZATION

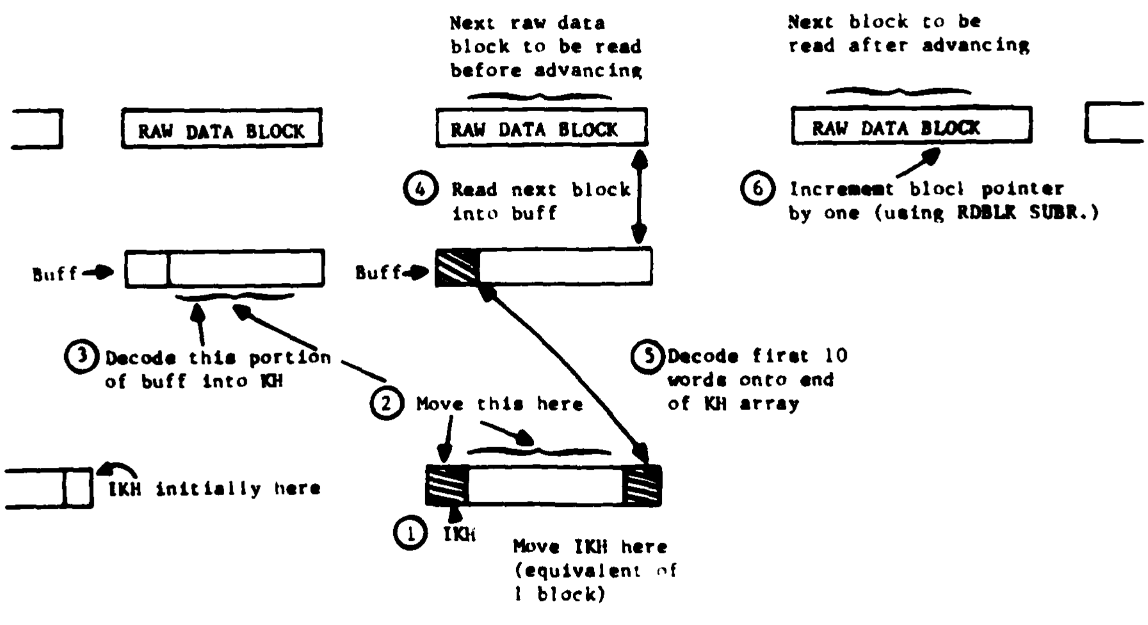


FIGURE II.1.B. ADVANCING CHARACTER ARRAY ONE BLOCK

between core memory storage and a reasonable time length. An additional record contains the half-day information for each of the 62 half-day records contained in the file and is used primarily for checking.

The time periods for the half-day records has been chosen according to the time that tapes are ordinarily changed at the Meppen site; hence, the first half-day starts at 10:00 and ends at 21:59; the second half of the record starts at 22:00 and ends at 9:59 of the following day. For example, the record, day 67, half 1, covers the period 67:10:00 to 67:21:59, and the record day 67, half 2, covers the period 67:22:00 to 68:09:59.

To put times on a manageable basis, all times stored and used in the programs are in terms of seconds from the beginning of the year. This conversion is handled by the function ITIME:

ITIME(ID,IH,IM,IS)=60(60(24(ID) + IH) + IM) + IS

A similar inverse function performs the conversion back.

The data stripped from a single minute of the Raw Data File requires 17 words of the 12240 word array **IDATA**. The structure of these 17 words is shown in Figure II.1.C. The first word of the 17 stores the time of the data; the remaining 16 words contain the channel data packed two values per word.

The location of the data in the IDATA array for a particular minute is determined by a base subscript IBASE (in which word the time resides). IBASE is defined as follows:

$$\text{IBASE} = \text{Int}\left[\frac{\text{IT} - \text{ITS} + [illegible]}{60}\right] \times 17 + [illegible]$$

where IT is the data time

and IT[illegible] = ITIME ([illegible]) for half 1

and IT[illegible] = ITIME ([illegible]) for half 2

The location of each channel data in terms of IBASE is shown in Figure II.1.[illegible].

The structure of a single data word is also shown in Figure II.1.C. Each channel data is stored in 24 bits (6 - 4 bit hex characters). How the value and discrete are obtained from the hex characters is also shown in the figure.

The Stripped Minute Directory contains room for 5 months of data. Currently each directory is used for only 1 month's data. For each record is contained: the record number, the tape number, day, half, and the date (day, month, year) that the stripped data was entered. An eighth entry for each record is a sorting integer. This is updated each time a record is added or modified. This array of sorting integer gives the record numbers in chronological order so that a sorted directory or sorted contents can be listed directly without sorting it each time.

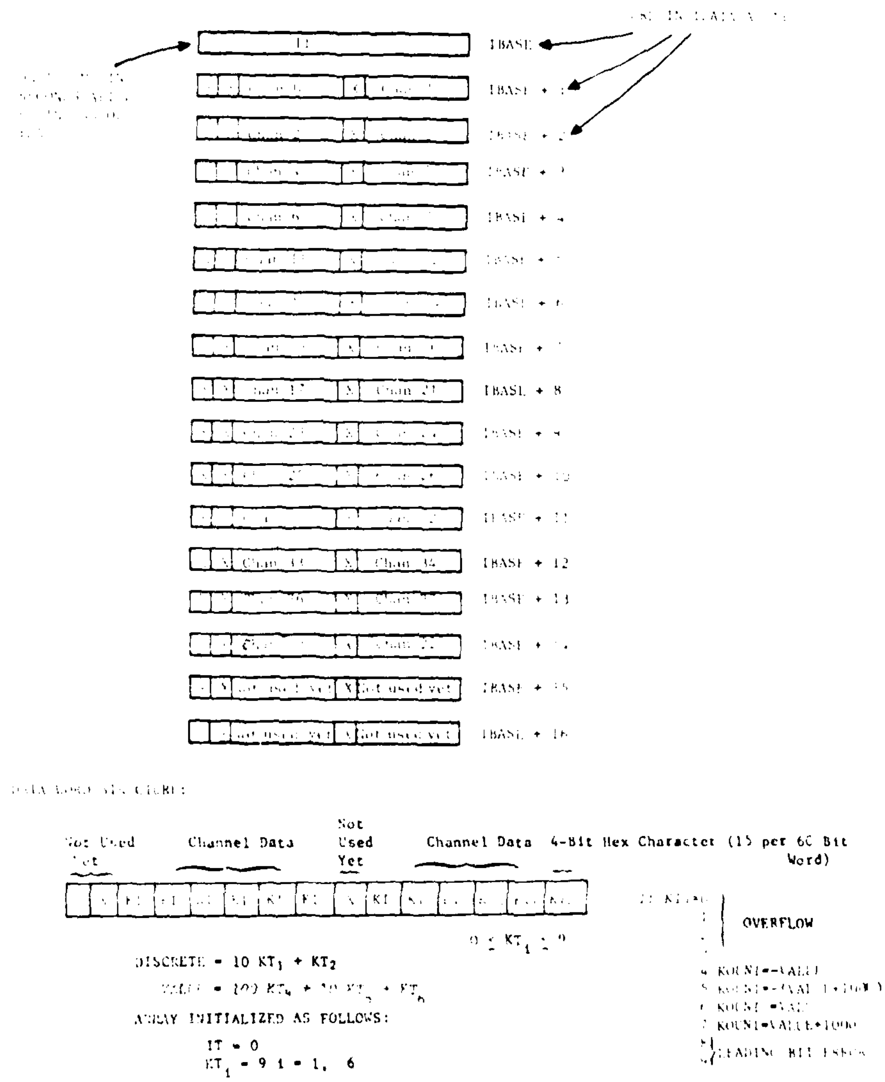


FIGURE II.1.C. STRIPPED MINUTE CHANNEL ARRAY STRUCTURE

II.1.3 MINUTE CHANNEL STRIP PROGRAM CAPABILITIES

The Minute Channel Strip Program allows the user to inspect the contents of a Raw Data File or strip data from minute channels. With the program one can:

* survey all or a large portion of the tape file
* access a particular data time or block on the tape file
* study a small segment of the Raw Data File contents in detail using several routines:
  - i) Dump a segment of the Raw Data File.
  - ii) Show the next several data times.
  - iii) Generate a summary table (profile) of a segment of the Raw Data File contents (data times, which channels are present, and an indication of their values). The entries in the summary table can be one of the following: all data, every minute only, every five minutes only, every 30 minutes only, every hour only, or every 4 hours only.
* strip the raw data from minute channels to create a Stripped Minute Channel File for a portion or for all of a half day record.
* automatically strip a whole tape
* merge two partial records of the same half-day
* list the directory of half day records already stripped in the order they were input and chronologically
* get a stripped data record from the disk file and load it into core
* inspect the contents of the stripped data record residing in core.

The program can be used interactively on a time-sharing terminal. The command language is very simple to use so that the experimenter may desire

to use the program himself. The command language is also flexible; one may use statements which are very readable or use short abbreviations for convenience. The program can also be executed in batch mode so that results may be output on the line printer.

To use the program one must first attach it, the desired Raw Data File, and the Stripped Minute Channel File and Directory residing on the disk. First there is a short log-in procedure in which the use specifies the current date and is requested to input the stripped tape number and the form of coding on the Raw Data File (either hex or character).

II.2 LUXMETER STRIP PROGRAM

The Stripped Luxmeter File and Directory structure and Luxmeter Strip Program capabilities are presented below.

II.2.1. STRIPPED LUXMETER FILE AND DIRECTORY STRUCTURE

Data for the stripped Luxmeter is stored in files which hold one month's data. Each record in the file is intended to hold the stripped data from 1 Raw Data File.

The Luxmeter instrument (which measures the horizontally and vertically incident illumination) is continuously rotating in a clockwise direction viewed from above, and the data to be entered into the Stripped Luxmeter File is that when the vertical axis is in the direction of the compass points. The average rotation rate is 12 minutes per revolution of 30° per minute. The instrument sample time is 4 seconds so that the instrument rotates through 2° between each sample. The algorithm used in selecting the samples is as follows: the first sample between 0°±2°, 90°±2°, and 180°±2°, and 270°±2° is taken as the north, east, south, and west sample respectively.

To determine the required size of the Stripped Luxmeter File, we note that at 12 minutes per revolution we should obtain 1 sample for the file every 3 minutes. Assuming a raw data tape may be up to 4 days long, we need to store at least 60/3 x 24 x 4 = 1920 samples per file. For each sample we store four values:

1. The data time (in seconds from the beginning of the year)
2. The horizontal channel data (channel 24) (COUNT + 1000 [illegible]
3. The vertical channel data (channel 25) (COUNT + 1000 [illegible]
4. The azimuth channel [illegible] (in [illegible]

Consequently we use an array dimensioned 4 x 2000 in the program. If the raw data for a particular sample was an overflow, 9999 is stored as the value for channel 24 or 25. If the raw data was not all integer digits or the leading bit was not zero, 8888 is stored as the value for channel 24 or 25.

For each record entered into the Stripped Luxmeter File, the following entries are made in the Directory:

(1) Record # (1 to 10)

(2) Raw Tape #

(3) First data time in record

(4) Last data time in record

(5) Number of data times contained in record

(6), (7), (8) Date record was entered in file (day, month, year)

Since there may be up to 10 records per file, the directory information array is dimensioned 8 x 10. Several months required more than 10 data tapes; two Luxmeter Files were generated for those months.

II.2.2 LUXMETER STRIP PROGRAM CAPABILITIES

With the Luxmeter Strip Program the user can do the following:

* strip all or a portion of the attached Raw Data File using a time efficient algorithm (strip) or a slightly less efficient algorithm (claw), which is more impervious to bad raw tape data, and load it into the Stripped Luxmeter File
* list the directory or records in the Stripped Luxmeter File
* get a stripped data record from the attached Stripped Luxmeter File
* dump any portion of the record in core

To use the program, one must use a procedure call as described above. There is a short log-in procedure (identical to that in the Minute Channel Stripping Program). The strip commands may then be used.

II.3 VISLAB STRIP PROGRAM

The Vislab Strip Program strips data from the Variable Path Function Meter (VPFM). The Stripped Vislab File structure is presented below. The Directory structure is identical, and the user's instructions are nearly the same as the Luxmeter Strip Program; only differences will be mentioned below.

II.3.1 STRIPPED VISLAB FILE STRUCTURE

Like the Stripped Luxmeter File, each record holds the stripped data from 1 raw data tape, and 10 records comprise a one-month file.

The VPFM instrument, unlike the Luxmeter, does not rotate at constant rate but rather positions itself and dwells at a compass point for a short interval of time. The algorithm used is to select all points which are within $\pm$ 2 degrees of the compass points and process them. For some periods of time the instrument was not rotating, and for this the algorithm accepts all points and assumes the instrument is east directed.

Data is normally recorded onto the raw tape once per second during a 10 minute period each hour. The stripping technique stores data meeting the direction criteria above for this 10 minute period and then is processed to obtain first, last, max, and min values for storing in the stripped array. Values outside the physical range of the readings are not used. Also the filter, which is assumed not to change over a ten-minute period is also inserted into the array.

For each 10 minute period the stripped file contains the following values:

1. Time (in seconds after the beginning of the year) of the first data point
2. First value
3. Last value

$\left.\begin{array}{l}\text{2. First value}\\\text{3. Last value}\end{array}\right\}$ for north direction ($0° \pm 2°$)

4. Max value
5. Min value

for north direction (0° ± 2°)

6. Number of samples used

7-11. Same as 2-6 but for east direction (90° ± 2°)

12-16. Same as 2-6 but for south direction (180° ± 2°)

17-21. Same as 2-6 but for west direction (270° ± 2°)

22. Filter used

Assuming that a raw data tape may be up to 5 days long (this was determined to be a better figure than the 4 day period used for the Luxmeter File), we must store the 22 elements a total of 5 x 24 = 120 times. Hence, the stripped data array is dimensioned 22 x 120 in the program.

The directory structure is identical to that used for the Luxmeter File.

II.4. MINUTE CHANNEL OUTPUTS

Routines have been written to obtain graphical outputs and tables from the Stripped Minute Channel Files. Typical samples are shown in Section II.

One can obtain:

1. time plots over any time scale (up to one month) (See Figure II.G.)
2. xy plots (up to one month) (See Figure II.H.)
3. histograms (up to one month) (See Figure II.I.)
4. two-hour stripped array profiles (See Figure II.J.)
5. data tables for up to 7 channels over specified period of time (See Figure II.K.)
6. daily maximum counts (See Figure II.L.)

All of the plot routines use a "plot composition algorithm". An array, which will be the plot, is first cleared and a grid is applied. Next, each function is applied by inserting characters at appropriate locations in the array. Finally, the composed array is printed out.

The configuration of axes used on the plot routines is shown in Figure II.4.A. The grid is determined by 4 numbers:

number of divisions in vertical direction ($ndiv_v$)

number of points per division in vertical direction (npd_v)

number of divisions in horizontal direction ($ndiv_h$)

number of points per division in horizontal direction (npd_h)

For the grid shown, these numbers are 8,5,5,10 respectively. The only restrictions on the grid size is:

$$ndiv_v * npd_v \leq 60$$

$$ndiv_h * npd_h \leq 120$$

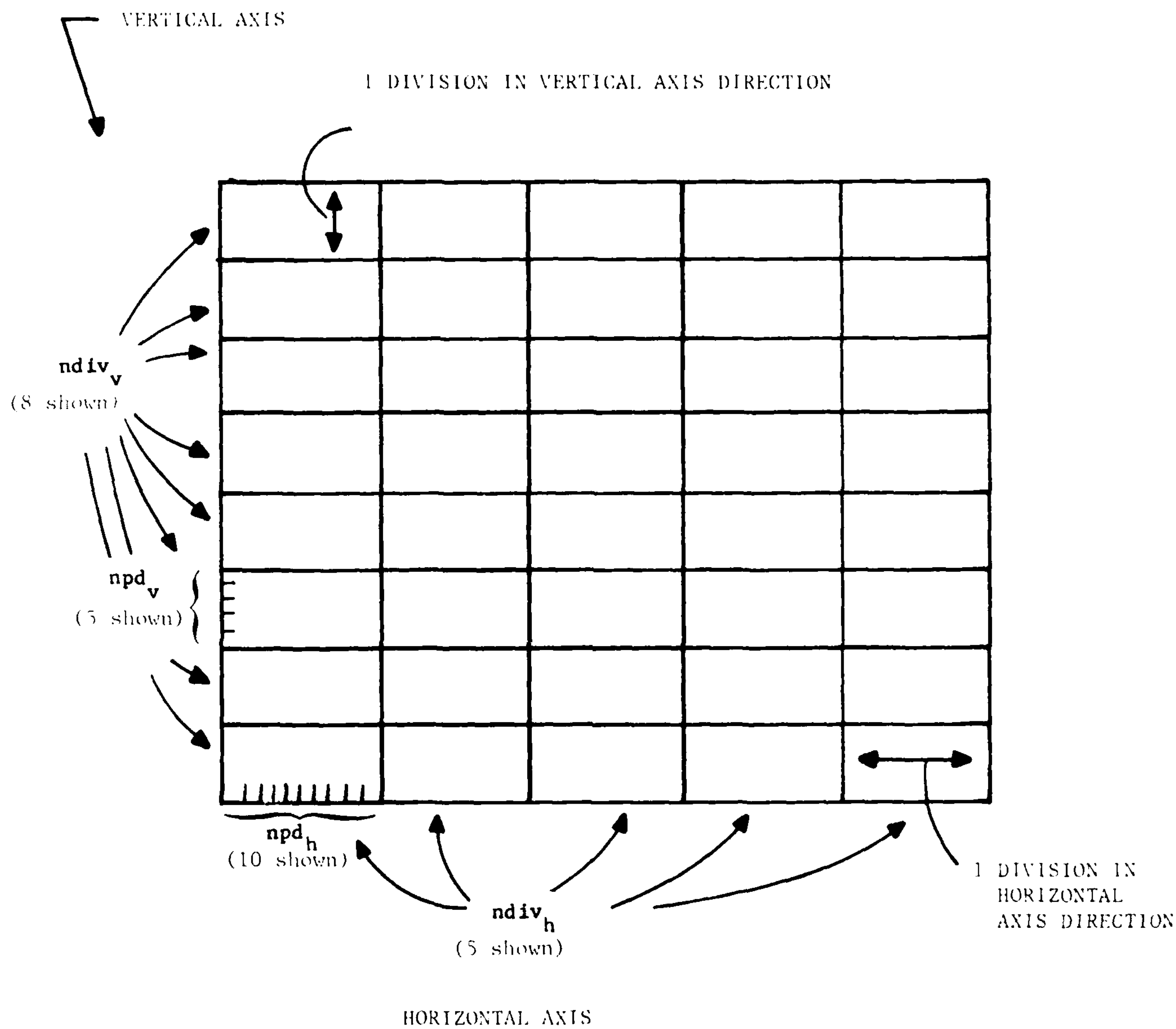


FIGURE II.4.A. Grid Configuration.

For time plots it is necessary to specify the number of minutes per division in the horizontal direction. This should be selected so that each space is at least one minute.

There are three options for scaling the variables to be placed in the grids.

Option 0 - automatic linear scaling. The bottom and top magnitudes are selected with an automatic scaling routine.

Option 1 - linear scaling. The values of the function at the bottom and top of the graph are specified by the user.

Option 2 - logarithmic scaling. The decipowers at the bottom and top of the graph are specified by the user. (decipower is the exponent i in 10^i)

Every channel to be plotted can be scaled separately. If no scaling is specified, Option 0 is used as default.

To make the plots as clear as possible, unique characters have been assigned to each possible function. Different filters for the BARNES instrument have different plot characters. These have been applied consistently whether the plot is a time plot or histogram. For example, the MRI Channel 2 data will always be plotted using the character B. A list of current channel numbers and the corresponding plot symbols used are given in Figure II.4.B.

LIST OF CHANNEL NUMBERS

CHANNEL NUMBER	PLOT SYMBOL	DESCRIPTION
0	A	MRI NEPHELOMETER Channel 1
1	B	MRI NEPHELOMETER Channel 2
2	C	MRI NEPHELOMETER Channel 3
3	D	MRI NEPHELOMETER Channel 4
4	E	ELTRO TRANSMISSOMETER Output
5	F	NIGHT PATH Filter
6	G	NIGHT PATH Output Signal
7	H	NIGHT PATH Range
11	J	VPFM Photo Meter
12	K	VPFM Azimuth
13	L	VPFM Filter Position
14	M	LASER PAR
15	N	LASER Power Meter
16	O	LASER Power Meter
17	P	LASER Gain
21	Q	BARNES IR TRANSMISSOMETER (without regard for filter)
210	6	BARNES IR TRANSMISSOMETER with filter 0
211	7	BARNES IR TRANSMISSOMETER with filter 1
212	8	BARNES IR TRANSMISSOMETER with filter 2
213	9	BARNES IR TRANSMISSOMETER with filter 3
23	R	RAIN GAUGE
24	S	ILLUMINOMETER Horizontal
25	T	ILLUMINOMETER Vertical
26	U	ILLUMINOMETER Azimuth
31	V	SCANNING NEPHL Angle
32	W	SCANNING NEPHL Scale Shift
33	X	SCANNING NEPHL Photo Diode
34	Y	SCANNING NEPHL Monitor
36	Z	EPPLEY PYROHELIOMETER Filtered Channel
37	*	EPPLEY PYROHELIOMETER Direct Channel

Figure II.4B Channel Numbers and Plot Symbols

II.5 GENERATING OPAQUE DATA FILE (ERIKFILE)

The Erik file is a monthly file containing values generated from the three stripped files, the Stripped Minute Channel File, Luxmeter File, and Vislab File. Three separate procedure files, ERIK, LUXERIK, and VISERIK are used to obtain values for the Erik file from each of the three stripped files. ERIK also contains several routines to output information from the Erik file.

II.5.1. ERIKFILE STRUCTURE

The Erik file is a one-month file containing 31 records, one for each day of the month. For months containing less than 31 days, 31 records are still used for simplicity; the extra records are merely neglected. Each daily record contains an array dimensioned 85 X 24. There are 85 entries for each hour of the day. There is one entry for each of the 78 data words in the standard hourly OPAQUE data set (see Fenn[1]), and one entry for each of the 7 different types of optical measurements, which indicate the reliability of the data. The entries are derived from a 10-minute period following the hour, Mean Local Solar Time. For tapes before April 12, 1977, this 10-minute period was between 30 and 40 minutes past the hour on the data logger clock (consistent with the local time zone). After that date the data logger clock was adjusted to Mean Lo il Solar Time, so this 10-minute period was the first 10 minutes of the hour. The first program was written for this latter case but corrected to accept times between 30 and 40 minutes past the hour. The program must be readjusted for processing data collected after April 12, 1977.

The 85 entries collected each hour consist of several different kinds defined in the document "Meppen Measurements Input Into OPAQUE Data Bank", which is reproduced in Appendix I. The 85 words for each hour was initialized as follows:

1. Fenn, R. W. (1978) OPAQUE, Vol 1, AFGL-TR-78-0011

1. (station number) 71

2. (date) year, month, day, packed into 6 rightmost digits

3. (time) hour (0,1,2,....23)

4. (duration of measurement cycle) 10

5-10 (comments and scattering-filter-humidity) 0

11-57 (measurement values) $-1 \times 10^{+30}$

58-77 (weather data) $-1 \times 10^{+30}$

78-85 *(data quality) appropriate* number of 9's

The processing of measurement values are of several types:

1. The MRI Photopic channel, Eltro, Horizontal Luxmeter, Night Path Luminance, and the east direction VPFM required the beginning value, end value, max value, min value, and number of samples used in the 10 minute period.
2. The vertical Luxmeter required one value from each of the four compass points.
3. The VPFM samples in the south, west, and north compass points were required in addition to the 5 values above for the east direction.
4. The direct Eppley required the beginning and end value.
5. The filtered Eppley and Barnes instrument required values entered, depending on the filter being used for the measurement.

If the values were supposed to be added to the array but were not either because the values were not physically present, or it was not possible to interpret the data, then the -1×10^{30} was changed to -9×10^{99} so that it is possible to distinguish between these two cases.

II.5.2. ERIK PROGRAM CAPABILITIES

The ERIK Program allows the user to process data from the Stripped Minute Channel File into the format necessary for the Erik File over a time period specified by a begin and end time. It also allows the user to output the contents of the Erik File in several forms:

1. contents summary of a given record
2. contents summary of all 31 records in the file
3. dump of all values of a given day between specified hours
4. dump of all values starting and finishing at specified days
5. display of specified channels only between specified days

Finally it allows the user to replace one particular channel of the attached Erik File with the corresponding channel of the attached Temporary Erik File over a specified time range.

Conclusions

The similarity of many of the programs described in Part I and Part II is due to the sequential nature of the data recording format and the need for a "quick-edit" approach to complement the stripping and formatting of the data base for subsequent access. The volume of data being processed requires that pre-editing of the data is a necessary prerequisite to stripping and formatting for it provides information on the data tape recording quality along with data parameters that serve as processing checks and verification. In attempting data recovery on especially "noisy" recordings, an independent means of verification is mandatory.

The programs described in this report constitute a complete system package to be used in the accessing, processing, reduction, and analysis of the OPAQUE data base generated at the U.S.A.F. field station in Meppen, Fed. Rep. of Germany. While some of the programs are unique to this application; i.e., the instrument calibration package and the specific data file packing algorithm, most of the programs can be readily adapted to other applications. All of the raw data tape utility, editing, processing, and display programs can be readily reconfigured to operate with different tape recording formats. The general format of the data files can be used in the processing of data from other sources, and the modularity of the structure allows numerable variations in the sequence of processing steps. Additional algorithmic modules can be linked into the program packages with the appropriate user-defined commands.

The use of procedure files to call and execute the system programs greatly simplifies the user-system interface. From the user standpoint, the elimination of a large number of control cards from the JOB run deck allows one to concentrate on the interpretation and analysis of the computer printout rather than correct control card errors.

Appendix I

ERIKFILE/OPAQUE DATA BANK FORMAT

Data Bank Word No.	Data Item	Measurement	Data Logger Channel
1	Station No.	= 71	
2	Date - Year, Month, Day		
3	Time		
4	Duration of Measurement Cycle	= 10	
5	Comment Numbers	= 000	
6	" "	= 000	
7	" "	= 000	
8	" "	= 000	
9	" "	= 000	
10	Scattering x100 + Filter x 10 + Humidity		
11	S_s BEG		
12	S_s FIN		
13	S_s MAX	MRI Nephelometer	2
14	S_s MIN	(After Mar 78 AEG Point Visibility Meter)	
15	N_V	= Number of Measurements	
16	E_g BEG		
17	E_g FIN		
18	E_g MAX	Eltro Transmissometer	4-0
19	E_g MIN		
20	N_V		
21	E_L BEG		
22	E_L FIN		
23	E_L MAX	Horizontal Luxmeter	24
24	E_L MIN		
25	N_V		
26	E_v^N (North)		
27	E_v^E (East)		
28	E_v^S (South)	Vertical Luxmeter	25 (compass points from 26)
29	E_v^W (West)		

Data Bank Word No.	Data Item	Measurement	Data Logger Channel
30	L_p^{NT} BEG		
31	L_p^{NT} FIN		
32	L_p^{NT} MAX	Night Path Luminance	6 (with 5 & 7
33	L_p^{NT} MIN		
34	NV		
35	F_p^E BEG		
36	F_p^E FIN		
37	F_p^E MAX	Vis Lab. Variable Path Function Meter	11 (Directions from 12)
38	F_p^E MIN		
39	NV		
40	F_p^S		
41	F_p^W		
42	F_p^N		
43	E_o^{1}	$\lambda = 0.945$	37 f = 1
44	E_o^{2}	$\lambda = 0.4$	37 f = [illegible]
45	E_o^{3}	$\lambda = 0.87$ Eppley Filtered	37 f = [illegible]
46	E_o^{4}	$\lambda = 1.06$	37 f = [illegible]
47	E_o^{5}	$\lambda = 0.75$	37 f = 5
48	E_o^{6}	$\lambda = 0.55$	37 f = 6
49	E_o^{7}	photopic	37 f = 7
50	E_o^{8}	$\lambda = 0.3$ to 3.5	36 BEG
51	E_o^{9}	Direct Eppley	
52	E_o^{10}	$\lambda = 0.3$ to 3.5	36 FIN

Data Bank Word No.	Data Item	Measurement		Data Logger Channel: Before Day 96	Days 96-145	After 145	
53	T_1	3-5μ BEG		f = 0	–	f = 1	
54	T_2	8-12μ	Barnes	f = 3	f = 3	f = 3	
55	T_3	8-13	Transmissometer	f = 2	f = 2	f = 2	Channel 21
56	T_x	Open or 4μ		f = 1	f = 0	f = 0	
57	T_8	3-5μ FIN		f = 0	–	f = 1	
58	$D_T^{\frac{1}{2}}$	Contel					
59	A						
60	B						
61	C						
62	D						
63	E						
64	F						
65	G						
66	H						
67	I						
68	N	Cloud Cover					
69	dd	Wind Direction at 10m					
70	ff	Wind Speed at 10m					
71	d_2d_2	Wind Direction at 2m					
72	f_2f_2	Wind Speed at 2m					
73	PPP	Pressure					
74	TTT	Temperature					
75	$T_dT_dT_d$	Dew Point Temp					
76	rrr	Rain Rate					
77	E	General Ground State					
78	QQQQ	Packed MRI Data Quality					
79	QQQQ	Packed Eltro Data Quality					
80	QQQQQQQQ	Packed Luxmeter Data Quality					
81	QQQQ	Packed Night Path Data Quality					
82	QQQQQQQ	Packed Vis Lab Data Quality					
83	QQQQQQQQQQ	Packed Eppley Data Quality					
84	QQQQQ	Packed Barnes Data Quality					
85	RRR	Total Rain for Past Hour				23 (Total R[illegible]	